

The Beginnings of Agriculture in Great Britain: a Critical Assessment

Volume I

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To Scott

I hereby declare that the work contained within this thesis was entirely composed by myself.

Jane Kenney

Abstract

A summary of the literature on the beginnings of agriculture in Europe in general, and Great Britain in particular, provides a theoretical background to the discussion. Models of relationships between hunter-gatherers and farmers are further investigated by a survey of the relevant anthropological literature.

Chapter 3 explores the nature of radiocarbon dating, and using a catalogue of relevant dates from Great Britain, assesses what interpretations can be drawn. There is also a brief discussion of Irish dates as these influence interpretations of the British data. The chapter concludes that there is no radiocarbon dating evidence for Neolithic-type cultures in Britain (and possibly not in Ireland) before the middle of the fourth millennium bc, but that the significance of this in relation to the beginnings of agriculture is unclear. The poor quality of the dates, and scarcity of late Mesolithic dates severely hinder clear conclusions.

The palaeoenvironmental evidence is then studied, with particular concentration on palynology. The nature of woodland disturbances and relevance of the elm decline to early agriculture are discussed. Early Neolithic agricultural practices, and the evidence for them are investigated, and the interpretational problems associated with finds of early cereal-type pollen grains are assessed.

The relationship of late Mesolithic and early Neolithic site distributions to each other and the landscape is discussed, with the conclusion that while some trends can be identified taphonomic processes largely obscure any original patterns. The nature of site distribution patterns and their change over the Transition is further explored in chapter 6 by a case study of the Dee Valley, Grampian. This involved the testing of known distribution patterns by fieldwalking and an analysis of lithic scatters to assess the problems of recognising scatters of specific periods.

Data from the above chapters is combined with information from other sources to assess whether any particular theory is supported by the evidence. While the evidence appears to the author to be weighted slightly towards some form of acculturation process, the conclusion must be that the available data is insufficient to answer the questions of how and when agriculture began in Great Britain. Greater emphasis needs to be placed in future on collecting data and tackling the inherent biases and errors in the evidence.

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On advice of my supervisor, and due to my own preferences, this thesis has been completed in as close to three years as possible. Inevitably this has led to compromises particularly in time spent on checking for errors. Naturally I take full responsibility for these errors, and hope that they do not seriously detract from the thesis.

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THE BEGINNINGS OF AGRICULTURE IN GREAT BRITAIN: A CRITICAL ASSESSMENT

CHAPTER 1: INTRODUCTION

The change to farming has long been perceived as possibly the single most important advance in human history; the foundation of social complexity and urbanism (Chapman 1985). The significance of the event has attracted much discussion, though the bulk of the literature consists of theory and speculation, with evidence notable for its scarcity. Kinnes (1988) has criticised researchers into early agriculture for using "*opinion as a substitute for research*" (p8), and has emphasized the need for more excavation. More authors are striving now to make their hypotheses testable, and calling for a search for further evidence (e.g. Dennell 1984, 1985 and Gregg 1988), but the quality and reliability of existing evidence is often assumed to be of an acceptable standard without it being subjected to detailed inspection. The repeated and uncritical quoting of "*facts*" can lead to the "*reinforcement of received ideas*", which in reality have little basis (Herne 1988 p12). While significantly extending the database may be beyond the scope of a PhD thesis, a critical assessment of the existing data would seem to be much needed, and long overdue.

The study of early agriculture is a vast field, and for the database to be considered in detail certain restrictions must be imposed. I intend to concentrate on evidence for the beginnings of agriculture in Great Britain. The nature of the evidence on the early Neolithic in Britain means that much of the study will concentrate on cultural material commonly associated with early British farming groups. As few of these artefacts can be demonstrated to be directly related to the practice of farming much of the evidence discussed will inevitably be somewhat indirectly related to the problem being studied.

Evidence relating to the beginnings of agriculture and Neolithic culture in Britain has been extensively discussed in the literature, and suffers badly from the use of "*opinion as a substitute for research*" (Kinnes 1988). Early agriculture in Great Britain must be seen in relation to the events on the Continent, but I have largely avoided discussing the Continental evidence in this thesis. It is hoped that this fault will be excused, as a detailed study of European evidence would have made the project far too large. I do include a summary of models applied to the beginnings of agriculture and the appearance of Neolithic material culture in Europe as an introduction to the period. The range of

possible models will then be further extended by a discussion of relevant anthropological theory and examples.

In order to assess which models are most applicable to Great Britain they must be compared to the available data, which itself must be critically assessed to ensure it genuinely can support the interpretations placed on it. The data will be assessed before discussing the Transition in Britain so that the latter can be carried out in the light of the former. There are many branches of inquiry relevant to the Transition in Britain, many of which are summarised in chapters 2 and 7, but they could not all be scrutinised in detail in one thesis, so compromise is necessary. Three main areas have been selected, which are of general significance in the formation of most theories on the Transition:-

dating evidence

environmental evidence

site distribution patterns

The date and duration of the Transition are implicitly or explicitly important to most theories, making the dating evidence a crucial area to investigate. In Britain there are very few sites where the material culture is claimed to contain both Mesolithic and Neolithic traits. With little direct evidence for the process of transition, the relationship between the two cultures must be gleaned from less direct sources. Environmental evidence can reflect economic change by detecting alterations in human landuse. Most models are, naturally, based on and compared to the archaeological evidence. Evidence for or against continuity in the artefact assemblages, especially lithic assemblages, is important in establishing the relationship of the two cultures. Exploration of this field would require the detailed analysis of numerous lithic assemblages. Such a study cannot be accomplished adequately within a generalised thesis such as this, and has been tackled only superficially here in relation to material from the Dee valley, Grampian. More emphasis will be placed on the spatial relationship between sites of the late Mesolithic and the early Neolithic to each other and their physical environment. This will be investigated both at a national scale, and at the scale of a single valley, to enable the identification of general patterns and detailed relationships, as well as identifying problems and biases affecting both scales. In conclusion the ability of the theory to explain the data, and for the database to be used to test the theory will be assessed. The emphasis of the thesis will be on the available data and its reliability, rather than on an analysis of theoretical approaches. I promise no solutions to the problem, but rather a synthesis and critique, which might,

hopefully, reveal the gaps and flaws in the present database, facilitate their correction, and progress towards a possible solution.

The beginnings of farming in Britain is a very broad subject, and, to paraphrase Bradley (1978 p1), *"a complete synthesis is impossible ..."*. This thesis can only be *"a personal interpretation of biased and elusive evidence"*, and all subsequent statements should be read with this in mind. In any literature-based research there is a danger that myths are perpetuated. For example, when Solberg (1989) describes the Linearbandkeramik (LBK) culture as *"strikingly uniform"* (p262), without information to the contrary, I can only assume that this statement is correct. The synchronicity of the elm decline is often quoted in both archaeological and palynological articles, but as discussed in section 4.4 below, this chronological interpretation is not as simple as is implied, and the concept of synchronicity may be misleading. A certain number of problems such as this can be investigated, but it would take a prohibitively long time to analyse the basic data behind every oft-quoted "fact". Some evidence must and has been taken on faith where it is not feasible to do otherwise.

Many of the most important terms used throughout have broad or multiple definition, and it is necessary to establish how they are to be applied in this thesis. The most frequently used terms may be divided into those relating to culture and those relating to economy, e.g. Mesolithic/Neolithic and hunter-gathering/farming, respectively. The Neolithic in particular is often defined, at least partly, by its economy, but it is valid to question whether the changes in material culture are necessarily closely related to economic type. To allow some assessment of this my use of a cultural term is not intended to imply an economic type, and *vice versa*. Despite being central to the discipline of archaeology the term "culture" is somewhat problematic. Though it may imply social, linguistic, and genetic differences between groups, it is generally used in archaeology to define groups of artefacts or structures that are frequently associated in time and space. The relationship between groups of artefacts and groups of people is often assumed, but can rarely be demonstrated. I will strive to avoid such assumptions, and intend the concept of a culture to refer only to the groupings of artefacts.

Though some authors (e.g. Price 1983) argue that "Mesolithic" should be used only to indicate the period between the end of the last ice age and the start of farming, it is commonly used to refer to certain assemblages, which, at least in Britain, are defined largely by the presence of microliths. Conventionally the British Neolithic is defined by *"the apparently sudden appearance in the archaeological record of domesticated plants and animals...the manufacture and use of pottery vessels, ground stone*

and pressure flaked flint and stone tools and the motivation and ability to construct large communal monuments" (Field and Cotton 1987 p72). I will use these definitions, with the exclusion of their economic aspects. This raises the question of whether the diagnostic artefacts used to define these cultures are particularly representative, and whether the cultures could be better defined in other ways. It may be that the attribution of certain artefacts as characteristic of specific periods needs reviewing, and some problems of this kind are mentioned below, but as I do not intend a systematic reassessment existing typologies have largely been accepted.

"Hunter-gatherers" is a commonly used term applied to a wide variety of non-food producing groups, and mostly I will use it in this generalised sense. "Agriculture" and "farming" tend to imply a certain intensification of food production, but for convenience I will use them to suggest any food producing activities involving morphologically domesticated plants and animals (Berry 1969, Mendoza 1986). These activities might possibly be carried on within a largely hunter-gatherer economy by peoples with a Mesolithic culture. An agricultural economy may be defined in anthropology as over 25% of the diet being agricultural products (Redman 1977). Evidence for agriculture in early Neolithic Britain is largely a matter of the presence or absence of indicators, so calculating even approximate percentages is problematic (Reynolds 1987), and beyond the scope of this study. Precise definitions of that sort are therefore not implied. Dog has been excluded from consideration as a domestic species, as its history appears very different from that of other domestic species (Piggott 1967), and it does not seem to have the close spatial and temporal relationship to the development of Neolithic material culture of other domestic species. As a short-hand I use the "Transition" to mean the whole process, which, in Britain, involved a typically Mesolithic culture with a hunter-gatherer economy transforming into a typically Neolithic culture with an agricultural economy.

CHAPTER 2: THEORETICAL BACKGROUND

2.1 The Transition on a European scale

"The transition from a hunter's life to that of a farmer and stock breeder represents by far the greatest step forward that humanity has taken during its whole long history on our globe. The hunter is perforce a wanderer who must forever be shifting his ground in pursuit of the herds of game. The farmer, however, is forced to lead a settled life. He is anchored to the spot where he has planted his crops. These he must tend till harvest time; he must protect them from the inroads of wild beasts and hostile neighbours. A settled life inevitably brings organisation; the growth of village communities; the emergence of tribes; and ultimately, the formation of states and nations" (Simpson 1963).

As a historian, rather than an archaeologist, Simpson summarises the traditional view of the transition to agriculture. The hard work, and some of the problems of early farming are mentioned, but none of Simpson's "inevitabilities" would appear to be universally true. Ethnological studies have demonstrated that the hunter-gatherer is not perforce a wanderer, nor the farmer necessarily settled (Gross 1983, Keegan 1986). Settled hunter-gatherers may have villages, tribes, and social organisation (Oberg 1973, Sheehan 1985, Spence *et al* 1984). In the last statement he is probably correct; no civilisations have been based on a hunter-gatherer economy, and it is difficult to envisage how this could be achieved. It is the ultimate historical consequence of the adoption of agriculture that makes the change so important.

The theories related to the origins and spread of agriculture are many and varied, drawn not only from the archaeological record, but also from anthropological studies, and other disciplines, such as ecology and history. Gebauer and Price (1992 p2) present a fairly comprehensive list of explanations, which have been suggested for the origins of agriculture. Most of these models can also apply to its spread from centres of domestication, but despite the variety of theories *"none seem to help us understand exactly why foragers turned to farming"* (Gebauer and Price 1992 p3).

The discussion has largely concentrated on theory building, rather than data collection and theory testing,^{which} encouraged some degree of polarisation in views. Theories generally propose either colonisation or acculturation as the main means of introduction of agriculture into most of Europe. The wave of advance model of demic diffusion is at

present the most influential of the former category, and the latter has multiplied into a range of theories, which might be divided into economic and social explanations. The need for more sophisticated models of transition, neither purely acculturation-based nor colonisation-based is now being recognised (Zvelebil 1986).

2.1.1 Colonisation

Concepts of active colonisation have largely been replaced by more passive theories of demic diffusion in early Europe. Most influential is the wave of advance model (Ammerman and Cavalli-Sforza 1971, 1984), which argues that farming was spread across Europe by the random expansion of the population in all directions, in short, unplanned moves. This is distinct from the planned, directional movement of "colonisation", and is described by the authors as *"a form of colonisation without colonists"* (Ammerman and Cavalli-Sforza 1984 p68). The stimulus proposed for this expansion is the population increase assumed to have accompanied the adoption of agriculture. The distribution of certain genetic types at the periphery of the ancient farming world is used to support the actual movement of people, rather than just ideas. However, the use of genetics to demonstrate the migration of Neolithic colonists is problematic because of *"the tremendous amount of gene flow that has followed similar routes in historic times"* (Donahue 1992 p74).

By comparing radiocarbon dates for early Neolithic contexts from across Europe Ammerman and Cavalli-Sforza calculated the rate of this movement, which is described as *"remarkably constant"* (1971 p686) across the Continent, and is claimed to have averaged 25km per generation. This model is based on relatively few radiocarbon dates, which were accepted uncritically. There was no discussion of their reliability, the relation of the dates to archaeological events, or their comparability. These omissions along with the use of central dates, not date ranges, suggests a poor understanding of the nature and problems of radiocarbon dating¹.

Though interested in the spread of the Neolithic "complex" as a whole (both material culture and farming), Ammerman and Cavalli-Sforza concentrated on dating the spread of agriculture, particularly cereals. However, they did not demand the presence of cereals on all dated sites, as this would have excessively reduced the database. This lack of precision about what was being dated is confusing (Zvelebil 1989); presumably Ertebolle sites could have been included as Neolithic, as both cereals and pottery have been found on

1. See chapter 3 for a full discussion of the problems associated with radiocarbon dating.

the sites, yet most authors consider this culture to be Mesolithic with a hunter-gather economy (Gebauer and Price 1990, Solberg 1989, Thomas 1988).

Ammerman and Cavalli-Sforza's dates reveal no obvious hiatus in the spread of the Neolithic "complex" from the Continent to Britain, though the earliest dates on LBK sites in Northern France tend to fall around 4000 bc (Bailloud 1973, Kinnes 1984, Phillips *et al* 1977), and there are no recognisably Neolithic sites in Britain before about 3500 bc, at the earliest².

Renfrew (1987) used the wave of advance model in his discussion of the expansion of the Indo-European languages, which he claimed were associated with the spread of agriculture. Anthropological evidence suggests that links between material culture and language groups are poorly understood and rarely simple, making archaeology poorly equipped to investigate the diffusion of languages (Zvelebil and Zvelebil 1988). Nevertheless, Renfrew links the spread of Indo-European languages and farming, and argues that the wave of advance was a whole series of local transformations, with farming communities expanding to produce new communities, leading to the accumulative effect of spreading agriculture across Europe. He claimed that there was no need to invoke population pressure as a stimulus, assuming that virgin land would seem attractive to early farmers, and would stimulate short moves. The wave of advance theory in general tends to assume some sort of mobile agriculture, such as is found in the tropics, where soil exhaustion necessitates occasional moves of fields and villages. However, soil exhaustion and the practice of swidden agriculture would seem to be unlikely in temperate Europe³. Reasons other than soil exhaustion for moving a village are given by some tropical agricultural communities (De Schlippe 1956, Gross 1983), but these do not necessarily apply to the environment and culture of the early Neolithic of Europe. In ethnological studies where villages are regularly moved, sites are often reused in rotation, so there is no lateral movement (Gross 1983, Gregg 1988). This seems to have occurred in early Neolithic northern France (Bailloud 1973). The problem then is how the wave of advance was initiated if lateral village movement was not inevitable (Chapman 1985).

Renfrew (1987) recognises that the rate of spread would not be as constant as Ammerman and Cavalli-Sforza suggest, there being considerable evidence for local changes in pace, and periods of stability. Though the Neolithic cultures of central Europe and southern Italy fit the wave theory fairly well, those of other areas do not. The rapid,

2. See appendix II for a list of early Neolithic dates from Britain.

3. For a full discussion on this see chapter 4, p183

but staggered, introduction of Neolithic traits to the coast of southern France and Spain was much faster than the wave of advance model predicts, while in much of northern and eastern Europe there was a very slow, gradual introduction of agriculture into Mesolithic contexts (Dolukhanov 1986, Zvelebil 1989). Even in southern and central Europe the spread of farming was not uniform, as mountain areas were initially avoided (Zvelebil 1986).

In some circumstances demic diffusion is the most probable explanation, such as the appearance of agriculture on Crete. There is little evidence for a permanent pre-Neolithic population on the island, and Broodbank and Strasser (1991) suggest it was colonised in a deliberate and planned way. Britain has similarities with Crete in that domesticates were physically imported, and the culture and economy were introduced wholesale. However, Britain is a much larger island, which already had a considerable population, giving the possibility of other methods of introduction. The Cretan example does suggest that in certain circumstances, even very early in the Neolithic, there was sufficient motivation for long and arduous journeys to colonise new lands. The motivation is not explained by Broodbank and Strasser, and is probably beyond the scope of archaeological investigation.

The homogeneity of the Linearbandkeramik (LBK) culture over a large part of central Europe seems to be consistent with the concept of demic diffusion (Ammerman and Cavalli-Sforza 1984). Even authors more inclined to support acculturation, agree with the probable introduction of agriculture to central Europe by colonists (e.g. Dennell 1983, Gregg 1988). Farming appears suddenly, spreading over the whole of Central Europe in 200-300 years (Keeley 1992), and the material culture seems very different to the local Mesolithic, but has parallels with south-east Europe. Yet very little is known of late Mesolithic activity in the area, and its contribution to Neolithic culture is unclear. Dennell (1983) claims that early settlements were variably located, rather than only in the most favourable situations, suggesting that the early farmers had no local knowledge of the land. However, it is frequently reiterated that these first settlements were only on the loess deposits of the river valleys, and therefore ideally located for farming (Halstead 1989, Thomas 1987). Hodder's (1990) discussion of the considerable variation in LBK grave types does not correlate with the usual impression of "*pathological conventionality*" in this culture (Keeley 1992 p82). Perhaps a reassessment of the data would cause the assumed homogeneity to be qualified.

The pronounced difference between Mesolithic and Neolithic culture claimed for central Europe (Keeley 1992) is possibly artificially enhanced by the lack of knowledge of

Mesolithic activity. The Mesolithic presence in the river valleys of central Europe seems to be slight, but most sites are hidden under alluvium, and it is possible that there are many more yet to be discovered (Dennell 1985). Many authors over-look the possibility that the evidence itself may be incomplete and misleading. Zvelebil (1986) argues that the direction and timing of the dispersal of farming is equally consistent with cultural diffusion as population movement. There is a great deal of evidence for continuity and regional variation in many areas of Europe, and local domestication would have been possible throughout the Mediterranean. Zvelebil concludes that the timing and reasons for a region to be converted to farming were highly variable.

In most areas the local Mesolithic culture disappeared soon after the appearance of the Neolithic, though the degree of overlap is hard to define (Gebauer and Price 1990, Bailloud 1973, Gregg 1988, and this thesis, chapter 3). The identification of the cultural affiliation of a site relies largely on diagnostic artefacts, if they are not present Neolithic sites might be interpreted as Mesolithic, and *vice versa*. There are generally too few radiocarbon dates from Mesolithic sites to securely date the disappearance of this culture throughout Europe (Gregg 1988). In the colonisation model the disappearance of Mesolithic culture has been assumed to be caused by competition either direct or indirect, economic or violent. The complete destruction of the Mesolithic population by disease was also suggested by Whittle (1977).

The term "colonisation" may recall recent imperial history, but this is a poor parallel for the Neolithic. Recent colonists have had massive technological superiority over the cultures on which they have imposed themselves (Dennell 1984, 1985). It seems unlikely that farming could have been spread by force of arms, in fact the settled agriculturalists, with their attractive stores, would be vulnerable to attack by the mobile Mesolithic groups. There is little evidence of hostility between the two groups, though Keeley (1992) argues that this can be demonstrated, at least in Belgium and Holland. There, distribution of supposedly contemporary Mesolithic and Neolithic sites appears to be complementary, possibly suggesting the existence of two groups which avoided each other. The few items of one culture found on the sites of the other can all be interpreted as weapons (Keeley 1992), though there is some evidence of a trade in flint between the Mesolithic groups and the LBK groups of West Germany (Gronenborn 1990). LBK enclosures are generally located round the margins of the LBK settlement zone, interpreted by Keeley as protection against an external threat. Contrary to Dennell (1985) there are examples of violent deaths in Mesolithic and Neolithic cemeteries (Price 1985, Price and Gebauer 1992), but the evidence implies these acts were carried out by people of their own culture.

Dennell (1984, 1985) and Gregg (1988) argue that economically the effects of agriculture would have been very localised and slight, as many Neolithic settlements appear to have been small, dispersed, and permanent; some were occupied for several hundred years (Whittle 1988). There is little evidence of mobile agriculture, soil exhaustion, or a massive population increase, so the effect on the Mesolithic population would not have been great. It seems unlikely that farmers could have destroyed the wild resources of the hunter-gatherers, significantly restricted their territories, or competed detrimentally with them. In this view, if farming caused any change to the forest environment it would be to increase the diversity of species and habitats, which could have only been beneficial to the Mesolithic groups. Mutual avoidance would have been possible because of the low population density, and the restriction of farming communities to the fertile valleys. However, amicable interaction could have been beneficial to both parties.

2.1.2 Acculturation

Many authors now accept that Mesolithic populations borrowed Neolithic materials and ideas, and became the first farmers of Europe (Price and Gebauer 1992). This is largely connected with developments in hunter-gatherer studies demonstrating in modern groups a level of social complexity and control over their environment not traditionally attributed to them (Whittle 1990). The acculturation argument claims that the Mesolithic culture disappeared because the hunter-gatherers became farmers. The transition to farming in Europe is characterised by "*enormous regional variability*" (Zvelebil 1986 p175), with local conditions accelerating or retarding the process. This variety suggests that the Transition probably occurred in different ways and for different reasons. Gregg (1988) and Dennell (1984, 1985) list numerous possible interactions between hunter-gatherers and agriculturalists involving various degrees of both competition and co-operation. Dennell (1984, 1985) created the concept of the porous frontier to describe contact and interaction between the groups. Zvelebil and Rowley-Conwy (1984) split the Transition into three stages: availability, substitution and consolidation phases. This system closely fits the evidence from Scandinavia and elsewhere in Europe, but it is descriptive rather than explanatory, relying on competition and a localised food crisis to explain the change.

Despite Zvelebil and Rowley-Conwy's statement that hunter-gathering and agriculture are "*mutually incompatible ways of life*" (1987 p105) ethnology has demonstrated that this is not necessarily true. Either one group may split its time and labour, or two groups may follow different strategies, but exchange products (Gregg 1988). These interlinked economies are resilient against resource failure as few factors can

adversely effect both farming and foraging systems. Even if population movement occurred Clark (1975) argues that this would not necessarily have caused general cultural change, as settled populations have a great ability to absorb cultural influences of immigrants, unless there is a desire by the natives to adopt the immigrants' culture. Extensive contact and interdependence does not inevitably mean that the two groups will become culturally similar (Hodder 1977), but it does provide a means for cultural change if this becomes desirable (Gregg 1988). In some areas, e.g. eastern Europe, hunter-gathering and farming co-existed for millennia. The two economic systems were integrated with no evidence of competition for time or resources (Dolukhanov 1986). Nor is the adoption of farming necessarily irreversible; farming groups in middle Sweden reverted to hunter-gathering, presumably because climatic deterioration reduced the efficiency of agriculture (Zvelebil and Rowley-Conwy 1986, Kaelas 1976).

Many causes of acculturation have been suggested, often these theories avoid monocausal solutions and attempt to reflect the complexity of the problem. Not all exclude the possibility of some population migration. Clark (1980) describes the spread of agriculture in Europe as *"the outcome of interaction between indigenous Europeans and exotic influences introduced at least in part by actual incomers"* (p60). A slightly different emphasis is given by Halstead (1989), *"the distinction between immigrant farmers and native foragers may often have been as meaningless as it is archaeologically opaque"* (p24). Physical differences between these groups may prove impossible to define. It should be possible to suggest whether the people of Mesolithic Europe were racially similar to those of the Neolithic from the skeletal evidence. However, Mesolithic burials are scarce, and there has been little work done on the problem recently. The scant skeletal evidence available is open to variable interpretation. Dennell (1984) sees no change between the Upper Palaeolithic and Neolithic, whereas Zvelebil (1986) claims some differences can be seen between Mesolithic and Neolithic skeletons, but emphasises the very small sample size, and the possible effect of diet on morphology. The ability, recently developed, to extract ancient DNA from most organic matter, including bone, may allow the advancement of this study in the future. However, the technique is still very experimental, and more research on the DNA of modern populations is necessary before any attempt could be made to interpret the genetic relationships of past populations (Brown and Brown 1992).

2.1.2.1 Explanations based on the physical environment and economy

The environmental changes in post-glacial northern Europe have been suggested as stimuli for economic and technological change, which may have made the Mesolithic groups more receptive to agriculture (Dennell 1983). It is suggested that the expansion of deciduous forests caused the development of a more broad spectrum economy throughout Mesolithic Europe (Dolukhanov 1986, Clark 1975, Waterbolk 1971b). Though resources became more patchy the total biomass increased, and there is no reason to consider (as Waterbolk 1971b does) that this broad spectrum economy was impoverished compared to the big game hunting of the Upper Palaeolithic. Coastal resources in particular could provide high return resources, some of which required only a low energy expenditure to extract (Grigson 1981), as well as low cost, low return resources that could support the old and young, who were unable to contribute to the economy in other ways (Bailey and Parkington 1988). In areas with abundant resources the increase in biomass enabled territories to become smaller, and groups larger, and broad spectrum economies probably represented economic intensification, rather than a struggle to survive in the deciduous forests (Thomas 1988). The nature of the resources and the stress imposed by their seasonality has been seen as a stimulus causing the development of sophisticated tools and techniques, and social organisation in Mesolithic Europe (Zvelebil 1986, Dennell 1983). These developments are in turn seen as preparing the Mesolithic population of Europe to accept agricultural ideas introduced from the Near East (Zvelebil 1986 p174, Rozoy 1989).

While some relationship between climatic change and the dispersal of farming has been argued for southern Europe (Butzer 1971), a relationship between climate and agriculture is even harder to establish in central and northern Europe. Existing radiocarbon dates for northern Europe suggest an expansion of farming across most of the region starting about 3200 bc (Thomas 1988). This general change over a large area suggests an influence of large scale factors, possibly climate, but there is no secure evidence for a climatic change at this time (Evans 1971a, Moore 1975). Some vegetational change does take place, most notably the elm decline, but it was probably largely unrelated to climatic change⁴. During the Atlantic period the climate seems to have been warmer than present (Lamb 1978), and resources, especially on the coast were at their most abundant, so domestic species seem unlikely to have filled a basic need in the subsistence economy (Nygaard 1987).

Some local environmental changes did occur, the most frequently discussed is the effect of changing salinity of the Baltic on the oyster population. Zvelebil and Rowley-

4. See section 4.4.

Conwy (1984) argue that Mesolithic groups relied on the oysters during the crucial period in early spring, when fat from other sources is scarce. The decline in oyster populations supposedly caused a resource crisis that led to the adoption of agriculture in Denmark. This is a very specific explanation, applying only to the particular conditions of Denmark, but it is not even adequate to explain the Danish evidence. A broad spectrum economy can adapt well to changes in resources. The variety of resources exploited means that the loss of one could be compensated for, even if it was a fairly important resource, and the society itself would not necessarily have to change. More significantly a large proportion of Ertebolle groups had inland territories, and relied mainly on terrestrial food sources. These groups seem to have adopted agriculture at the same time as the coastal groups (Thomas 1988).

While a resource crisis may not fit the Danish evidence particularly well, this concept has been applied in a more general way. The inland hunter-gatherers of Europe had less abundant, and more dispersed resources, than those on the coasts, resulting in more mobile strategies similar to the classic egalitarian hunter-gatherers of anthropological literature. Gregg (1988) suggests that these groups probably experienced some degree of dietary stress in certain seasons, e.g. when game animals are fat depleted. The availability of carbohydrates at this time would increase the carrying capacity of the system. Most edible plants in temperate deciduous forests are "*extremely poor sources of food energy*" (Bonsall 1980 p462). The mixed oak forest has few easily stored high energy resources, and there is little evidence of exploitation of those that existed. Though nuts are nutritious they are generally highly seasonal, with short harvests, and are unreliable from year to year. Hazel trees are not as productive as Clarke (1976) has claimed, as he used figures for cultivated trees (Bonsall 1980). Bracken rhizomes that Clarke also claimed would be important were probably not widely available until the end of the Atlantic period, when they start to appear more commonly in the pollen record (Bonsall 1980).

It is possible that plant foods made up 20% of temperate foragers diet, and the success of inland Mesolithic groups suggests that some wild carbohydrates must have been exploited, but this may have been the main limiting factor on the population (Gregg 1988). The presence of farmers in a hunter-gatherer group's territory could have provided an alternative source of food, and if this food was acquired by exchange rather than raiding, this may have lead to close contacts between the groups (Gregg 1988). Dennell (1983) emphasises how much more efficient the harvesting, storing and processing of cereals is than that of temperate wild plant foods.

Dennell (1983) has interpreted palynological evidence for forest clearance associated with fires as evidence for Mesolithic forest or game management. If Mesolithic groups in Europe deliberately manipulated the environment to increase its productivity the basic concepts of farming might not have been entirely alien to them. While clearance episodes associated with fires are widely recognised, demonstrating that they represent game management or herding is problematic⁵. The possible familiarity of Mesolithic groups with concepts related to food production does not actually explain why this was adopted. An increase in efficiency, and the ability to support a larger population or store more food, is expensive in terms of labour and increased social problems (Dennell 1983). Though Neolithic farming would have been potentially more productive than Mesolithic hunter-gathering, farming demands more labour and presents an increased economic risk compared to a broad based hunter-gatherer economy (Case 1976). Also, though more food could be produced, there is some evidence that an agricultural diet was not necessarily as nutritionally well-balanced as a hunter-gatherers' diet (Barnicot 1969, Larsen 1983). A heavy reliance on cereals may result in nutritional deficiencies, and small body size, and where agriculture is associated with sedentism there may also be a dramatic increase in infectious epidemic diseases (Nickens 1976). The motivation for economic change, despite the associated problems, needs to be studied. There seems to be no reason why the change to agriculture should have been inevitable, even in the interior of Europe, or where hunter-gatherers were well acquainted with the agriculture of their neighbours. In Eastern Europe exchange between hunter-gatherers and farmers enabled their co-existence until 1000 bc (Dolukhanov 1986).

The motivation for economic change has also been explained by a rise in population at the end of the Mesolithic period, putting strain on the existing subsistence economy, and stimulating greater cultural complexity (Clark 1989). Theories based on this premise assume that archaeology is capable of revealing the size of past populations. Estimating population size from archaeological data is extremely difficult. For example, an increase in settlement size could mean longer occupation of single sites, not a larger number of people. Similarly more sites could be due to the adoption of a more mobile life style. Fewer sites could mean that the population has moved to another area, and does not necessarily indicate a drop in population, other than at a local scale (Blankholm 1987). More important than these considerations are the biases that affect most archaeological evidence. Sites may not be discovered for a wide range of taphonomic reasons; alternatively, sites in a particular area may be well preserved and easily discovered, but

5. See chapter 4, p128-129

have been no more numerous in the past than elsewhere⁶. So few sites are preserved and discovered, and even fewer are excavated, so it would seem that a calculation of population from known settlements is almost impossible (Rozoy 1989).

A steady increase in population in Mesolithic north-west Europe has been argued, mainly due to later Ertebolle sites being larger and more frequent than earlier ones. This could indicate relocation of people to the coast from inland, or loss of land due to the rising sea level, rather than an increase in population. When referring to population pressure it is increased population density that is important, not an absolute increase in population. Density may increase even when population numbers are declining, if the area occupied, or available resources, decline faster than population (Grabner 1991). Locally the increase in population density, whatever its cause, would have the same effect as an overall increase in population (Dennell 1983). The study of social territories, as represented by artefact types and styles, has also been used to support the idea of population increase. The social territory is equated with an area occupied by inter-related bands of hunter-gatherers, and which is the total area drawn on for all resources. It is assumed that groups inter-related through a mating network would possess certain similarities of material culture. Gendel (1984) demonstrates the variation in definition of boundaries and concepts of tribe amongst recent groups. Denser populations in more productive environments are more likely to strictly defend their boundaries. Thus social territories may be expected to have been fairly well defined in Mesolithic Europe. With higher population densities, mating networks can be spatially smaller, reducing the need for mobility, and encouraging sedentism and cultural complexity. Studies of microliths (Jacobi 1979, Gendel 1984) and antler points (Verhart 1990) have been interpreted to suggest a decrease in territory size, and greater definition of boundaries in the late Mesolithic. Unfortunately the use of artefact variation to define social territories is highly problematic, the relationship between material culture, language and social groups being far from straight forward. Gendel (1984) admits that reality was probably much more complex than this simplistic model suggests, and Jacobi, who largely initiated this approach, believes it has "*founded*" through a lack of appreciation of what constitutes style in ancient artefacts (Jacobi 1987 p164). The definition of territories is vague and open to a variety of interpretations, and even in the late Mesolithic, some groupings identified as social territories are still very large, e.g. covering areas of 30,000 km² (Verhart 1990). Even if these territories were real phenomena, it is unclear what changes at this scale mean for

6. Taphonomic factors related to the survival and discovery of archaeological sites are discussed in chapter 5.

local groups, and how they relate to the development of social complexity, or the adoption of agriculture.

A rather different approach has provided more convincing evidence for the existence of small, well defined territories, at least in Denmark (Price and Gebauer 1992 p99-100). The measurement of ^{13}C in human and dog bones from inland and coastal sites in Denmark indicated that these sites were not part of the same territories, as inland populations showed no evidence of having a significant marine component in their diet (Price 1985). Even if social territories did become smaller, there is little unequivocal evidence of an associated trend towards sedentism, even in the large shell mounds of the Ertebolle. Though some of these were in use for over 800 years, activity seems to have been seasonal. The presence of ceramics at first sight suggests sedentism, but they could have been made quickly and thrown away when the people moved on (Blankholm 1987).

General population increase is difficult to define, but the evidence from some areas, particularly Scandinavia, does suggest a local increase in population density. Changes in sea level, particularly the submergence of the North Sea Basin, may be significant (Zvelebil and Rowley-Conwy 1986). Nygaard (1987) proposes that the introduction of agriculture to Norway may have been related to local population density along the coast, due to a decrease in mobility, and smaller territories. Neolithic residential units appear to be no larger than Mesolithic ones, suggesting there was no further increase in population. A shift to exploiting marine resources seems to have caused this concentration of population on the coast, and along rivers. Larger co-residential groups were needed to exploit these resources, so sites grew and were occupied for a longer duration. Aggregation and semi-sedentism probably encouraged increased social complexity, creating a suitable background for the introduction of agriculture (Nygaard 1990).

Butzer (1971) proposes, as a model for demographic changes in early Neolithic Europe, a vicious circle of agriculture, population increase, agricultural intensification and further population increase. However, there seems to be no evidence of this in the archaeological record. Contrary to Butzer (1971) there is no suggestion that "*life and death*" were less "*precariously balanced*" (p314) after the adoption of farming. Zvelebil (1986) sees little archaeological evidence for any significant population increase following the introduction of agriculture. He considers the demographic potential of the early Neolithic to have been over-estimated, while the population size of the late Mesolithic may have been under-estimated. Dennell (1984) suggests the rate of population increase in early Neolithic Turkey and northern Greece was 0.1%, and Carneiro and Hilse (1966)

calculate a similar rate for the Near East. Though the calculation of ancient rates of population growth must be highly problematic, it is unlikely that these large, fertile areas were over-populated by 6000 bc, when agriculture started to spread north and west. Nor is there evidence of extensive infilling by this date. The probable low population densities in the above areas make it unlikely that population pressure stimulated migration and the spread of agriculture.

According to Dennell (1983) large parts of Greece and Crete appear to have been unoccupied by farmers till 4th or 3rd millennium bc. In Central Europe population growth, after the initial spread, appears to be low, and restricted to infilling between original settlements, rather than the expansion of the farmed area as a whole. This would imply that the initial expansion of farming took place by a process other than population growth and expansion, which might be expected to be slow, and produce a fairly dense settlement pattern (Dennell 1983). The rapid increase in farming peoples at the start of the Neolithic, followed by demographic stability, suggests the increase was due to recruitment from hunter-gatherers, not from a high birth rate (Dennell 1984).

2.1.2.2 Models of change based on social processes

Theories dealing with environmental and economic transformation suggest certain stimuli for change, but do not explain why agriculture was adopted rather than alternative strategies. The ability of agriculture to support more people or to produce a surplus was probably evident by the time farming reached central and north-west Europe. However, the desire for increased production or economic intensification is not inevitable, and needs explanation (Bender 1978, Sahlins 1974).

The importance of the social environment in social and economic change was championed by Bender (1978), and this approach has become increasingly popular. Cultural and economic change would appear to be complex events, and the complexities of social theory seem well suited to explaining these events. In contrast Chapman (1985) believes social theory to be of no use in archaeology, as it cannot be tested. While it may be possible to create social theories of change that are capable of some degree of testing against the archaeological evidence, little actual testing has been carried out. Social reasons for change are difficult for anthropologists to investigate because they are closely associated with the particular history and world view of a group that from our cultural stand-point may be difficult to comprehend. Social and economic change may be initiated for reasons that seem trivial or ridiculous to outsiders, but are important to the

participants (Fletcher 1977). To archaeologists dealing only with material culture the problem is considerable, if not insurmountable.

Bender (1978) suggested that social obligations could stimulate a demand for surplus production, and so require that a more intensive economic system be adopted⁷. This is linked to the development of social stratification through the control of exchange goods and stores by particular individuals, who would then have a personal interest in encouraging economic intensification in the group. A social demand for intensification and surplus could not only cause change in the economy, but also encourage the development of sedentism, technology and population increase. Runnels and van Andel (1988) have similarly argued for exchange motivating the initial development of agriculture, and though they do not do so in the article this could be extended to explain the spread of both agriculture and other Neolithic traits across Europe. Agriculture may have been attractive because it could provide storable, portable commodities suitable for conversion into wealth and social prestige through exchange.

The importance of appropriate risk management strategies is stressed by Rozoy (1989). Where Mesolithic groups were reducing their mobility a need for a new form of risk management was created. When a group could no longer move to avoid resource failure, some alternative was required. This probably encouraged the development of storage and lithic technology, and exchange networks. The exchange and accumulation of prestige objects and obligations, referred to as social storage (Blankholm 1987), could allow the establishment of very long distance exchange networks to provide an insurance against regional resource failure. Such networks appear to have existed since the Upper Palaeolithic, but they possibly gained in importance in the late Mesolithic. The rapid diffusion of new artefact types throughout Europe in the Mesolithic implies that there were efficient exchange routes, which must have been favourable to the spread of agriculture (Rozoy 1989).

Blankholm (1987) suggests that the presence of exotic items on Ertebølle sites indicates the practice of social storage, which if heavily relied on it could lead to the development of economic and social inequality. The crisis leading to the adoption of agriculture could have been personal, a threat to the power of an individual, who had gained status through controlling the exchange system. This threat could have been overcome by exploiting the system further; using the food surplus that the adoption of agriculture could produce. Hunter-gatherers have many alternatives for adapting to

7. See p44 for further discussion of this idea in relation to anthropological evidence.

resource loss, but none have the potential for producing surplus that farming possesses (Blankholm 1987). The concept of gaining prestige through competitive feasting, seen in ethnology, especially amongst the North West Coast Indians (Kan 1986, Oberg 1973), may also have played a role in the adoption of agriculture. Cereals were ideal for storing in preparation for feasts, and the high return in prestige would justify high expenditure in labour and time (Hayden 1992).

These models put forward by Bender (1978), Blankholm (1987) and others imply the development of some form of social elite. The concept of social elites in the late Mesolithic is problematic because there is so little evidence for their existence then. Clark (1975 p29) states that *"one of the characteristic ways in which social elites have sought to establish their identity is by acquiring exotic possessions and adopting exotic ways"*, and the presence of exotic items may reflect the presence of a social hierarchy based on the control of exchange networks. Even in ethnography the identification of social inequality can be difficult. Leacock (1991) emphasises the risk of imposing ethnocentric perceptions on other cultures; seeing inequality where it is expected, or concentrating on the egalitarian aspects of a society and ignoring evidence of inequality. Flanagan (1989) stresses that no known societies are truly egalitarian, all possess minimal social stratification based on age, sex or personal ability. For the development of social elites classifications must cut across these basic divisions, and each social level include individuals of all ages, sexes and abilities. The identification of these rather subtle differences is difficult using the physical remains available to archaeology. Larsson (1990) recognises our inability to intuitively understand the meaning of symbols of past societies. The relationship between social elites and archaeological evidence, such as variations in burial practices or the presence of exotic or beautifully crafted artefacts, cannot be clearly demonstrated.

Exchange networks are seen as important in both introducing exotic ideas and objects, and in creating the opportunity for appropriation of wealth and power. These networks may have included both Mesolithic and Neolithic communities, and in cases where Neolithic culture seems to have been spread by sea, the Mesolithic people were more likely to possess the necessary sea-faring skills (Case 1976). Sedentary groups have a greater need to obtain raw materials through exchange, as they cannot acquire them directly, and it seems probable that Neolithic groups would encourage exchange with mobile Mesolithic groups (Care 1982). The actual archaeological evidence for this is scarce (Keeley 1992), but the early Neolithic level at the site of Bruchenhöfen, western Germany, produced Mesolithic-type trapezoidal microlithics and flint imported 200km away. Gronenborn (1990) argues that this represents exchange between Mesolithic and

Neolithic groups, as the flint was probably transported by mobile groups, rather than the sedentary early Neolithic farmers. This suggestion is supported by the evidence that flint export declined after the source area finally adopted the LBK culture, and the groups living there presumably became sedentary. The presence of sheep on sites with otherwise typically Mesolithic cultures in southern France (Geddes 1985), also implies some type of exchange between Mesolithic and Neolithic groups.

It seems probable that mobile hunter-gatherers played an important role in Neolithic exchange networks as they are more likely to be aware of events beyond their territory, and to have direct access to more distant resources than agriculturalists (Dennell 1983). Alliances between farmers and hunter-gatherers could have provided the former with extra labour and protection from raiding, yet the exchange of food for these benefits would leave little archaeological trace (Gregg 1988, Dennell 1984¹⁹⁹⁵). Evidence that Mesolithic groups in Belgium and Holland may have obtained pottery and domestic cattle from other ceramic Mesolithic groups to the north-east, rather than the closer LBK groups, indicates the probable complexities of these exchange networks (Keeley 1992).

The occurrence of exchange alone probably did not cause a significant economic and social change. This is demonstrated in Denmark, where Ertebolle groups carried out exchange with neighbouring farming groups for about 600 years before adopting agriculture (Price and Gebauer 1992). Imported items on Ertebolle sites include fossil teeth ornaments and shoe-last axes from Poland, and bone combs, T-shaped antler axes, and the production of pottery suggest LBK influence (Gebauer and Price 1990). However, ideas acquired during contact with Neolithic groups may have encouraged Mesolithic social change.

The development of regional exchange networks may have been an essential prerequisite for the adoption of agriculture in many parts of Europe. In northern Europe cultivars are at their ecological limits, a bad year could destroy crops over a wide area. To combat this risk reliance on long distance exchange would be necessary, rather than just exchange with neighbours (Halstead 1989). The probable importance of this system has led to the suggestion that most early Neolithic traits adopted by Mesolithic groups may have been primarily prestige symbols, including domestic animals and pottery, to be used in exchange as part of a risk buffering social mechanism (Clark 1989). The status value of Neolithic traits may have encouraged the introduction or copying of other Neolithic items (Dennell 1985). Zvelebil (1986) suggests prestige as the main reason for the adoption of pottery and caprines on the west Mediterranean coast.

Thomas (1988) has suggested that the attraction of Neolithic traits to the Mesolithic people was the desire for a more intensely ceremonial life. In this view the Neolithic did not equate with material culture, but with "*arcane and magical knowledge*" (p63). Monuments were an important part in the initial stages of adopting a truly Neolithic lifestyle, as they were part of basic social organisation of the Neolithic. Prestige goods and monuments "*were not optional extras, but were a constituent element of the Neolithic package, as much so as crops or livestock*" (Thomas 1988 p64), making the adoption of this whole structure rapid and complete. Hodder (1990) suggests that this process did not occur before Neolithic concepts had developed, through internal processes, into a form that was more acceptable to the Mesolithic groups of north-west Europe. While this could explain the late appearance of agriculture in the north-west it relies on esoteric concepts largely divorced from archaeological evidence.

Attempts have been made to deduce levels of social complexity from archaeological data by relying on evidence from anthropology which suggests that distinct changes in material culture are usually associated with increased social complexity⁸. In reality this is rarely as unproblematic as might be hoped. Gregg (1990) has used the number of steps in the manufacture of an artefact as an indicator of technological complexity. He suggests from this that technological complexity increased through the Mesolithic. However, he only analysed 4 sites covering late glacial to late Mesolithic, and these may not be representative of their periods. Mesolithic burials from western Europe seem to suggest the development of progressively more complex rituals, and greater differentiation in the way that individuals were treated. Mesolithic burials are much more common than those from the Upper Palaeolithic, and there is an increased tendency to bury in cemeteries (Clark and Neeley 1987). However, much of the difference in numbers can be attributed to differential preservation. Also, most of the cemeteries found in northern Europe are in southern Scandinavia, so it is impossible to be sure how general traits found in them are. A lack of cemeteries could mean they were located in areas now submerged, or where little research has been done, alternatively ¹³equally complex funerary rituals may have been carried out, which are less archaeological¹³ visible than inhumation. While the overall data suggests some increase in the frequency of burial and the complexity of the ritual, the evidence is too patchy for it to be used to support increasing social complexity in more than a very few areas, notably southern Scandinavia.

Exchange networks and the development of social inequality may have been long term aspects of Mesolithic society, but models of social change tend to rely on these

8. See chapter 2, p31-33

continuing internal processes reaching a point at which they force change. Clark (1975) uses ideas from traditional Marxist social evolution to describe this process. While traditional societies survive by exacting a high degree of conformity there is an interplay of tensions in even the most stable society, and Clark (1975) argues that "*once the threshold is passed at which the cost of maintaining conformity exceeds the benefit that this conformity confers, then normal evolutionary forces would favour a radical adjustment,...the appearance of new social norms*" (p25). This process would leave some traces of cultural continuity, but would also cause radical and rapid cultural changes, which then become stable themselves; a description which fits most of the evidence for the Transition in Europe quite closely.

Personally the social approach to the Transition seems to have more potential than simple environmental or economic stimuli, as all changes in human groups must be seen in their social context. Even the most obvious facts are interpreted by those who perceive them. Population density and food stress have no meaning outside the social context, there being few absolutes about what initiates stress (Kesinger 1983). Ecological ideas cannot be imposed on human groups in any simplistic way, and practitioners of both archaeology and anthropology are increasingly acknowledging this. When scientific principals were first widely used in archaeology, it seems that science was mistakenly equated with simplicity because physical and biological sciences tend to approach systems at their most simple level. It is probable that human society does not have a simple level, and that it can only be understood by dealing with its complexity. While the examples discussed above suggest that archaeology might be unable to achieve this except in a rudimentary way, it seems probable that we will learn more from attempting this approach than from artificially simplifying problems from the start.

2.1.3 Great Britain

Colonisation was assumed in the past to be the only obvious way that agriculture could reach Britain, and in some quarters this view is still maintained (e.g. Bradley 1978, Darvill 1987 p49). The main reasons argued for the occurrence of colonisation are: the simultaneous appearance of Neolithic culture all across Britain, the maturity of the economy, and the extreme nature of the transition, which involved changes in social and religious life as well as in technology and subsistence (Spratt 1982 p126). Piggott (1972) considered that the barrier of the English Channel "*renders it inevitable that the first adoption of agricultural techniques in British prehistory could only have been by means of an actual immigrant movement of peoples*" (p219), though he later came to see the Channel as a means of transport and communication (Piggott 1979). Even

Clark (1966), while fiercely criticising the "*invasion neurosis*" (p173) in much archaeological theory of the time, believed the invasion hypothesis to be "*essential and justified*" (p176) in relation to the introduction of farming to Britain. The opposing view, heavily influenced by Clark's article, despite this inconsistency, tended to see the colonisation view as imperialist (Dennell 1983), and suggest instead an active role for the native Britons. An intermediate opinion suggests small scale migration, then spread of the Neolithic culture among the native population (Healy 1984). Most recent opinion favours an important role for British natives in the Transition (Whittle 1990), though the apparent speed and completeness of the Transition, and the lack of intermediate sites means that the colonisation argument is still persuasive.

The "*mature and non-experimental*" (Case 1969 p177) nature of early British agriculture has been used as evidence for colonisation with an archaeologically invisible pioneer stage, but Dennell (1984) uses the same characteristics to argue for acculturation in south-east Europe. There appears to have been neither a pioneer stage nor early failures in early south-east European agriculture. Pioneers would use expedient technologies, but the earliest Balkan Neolithic has fine pottery and substantial houses. It appears that the earliest Neolithic people were familiar with the landscape, as settlements were located, from the first, in the most favourable areas, and occupied for generations. There was considerable cultural diversity in the Balkans, but no close parallels with the cultures of the Near East. In Dennell's interpretation this is because the first farmers were native people, with an understanding of the local environment, and an established subsistence base to rely on until agriculture was fully established. Similar evidence survives in Britain, and a similar conclusion could be possible.

Artefacts have played a major part in the discussion on the first farming in Britain. The close association of typically Neolithic artefacts with the earliest evidence of agriculture suggests their introduction through similar processes. Initially the concern was to locate the homeland of the assumed colonists through comparisons between British Neolithic artefacts and ones on the Continent. Piggott (1970) lists possible origins of traits in the British Neolithic, as does Whittle (1977); both suggest an area of origin in Northern France, in a culture drawing aspects from both the east and west, but this culture has never actually been identified. Parallels can be drawn with funnel-necked beaker (TRB) and Michelsberg cultures, but these are contemporary with the early British Neolithic. The trumpet lugs of south-west Britain are, according to Mercer (1986), not very similar to their supposed parallels in the Northern Chasséen. Leaf-shaped arrowheads appear to be an insular development, though they have some distant similarity to the piercing arrowheads of the Roessen culture (Whittle 1977, Kinnes 1988). Several apparent Breton

prototypes for British megaliths are in fact contemporary with the British tombs (Piggott 1972). Case (1969) claims the parent culture to the British Neolithic has probably been lost due to submergence by the rising sea level. Case (1969) and Whittle (1977) also suggest the stresses of migration would cause cultural dislocation, though it seems more likely that stress would result in an emphasis on, not reduction of, social identity (Pitts and Jacobi 1979). In any case these arguments are based on an absence of evidence rather on its existence. Dennell (1983) is particularly critical, "*Such explanations are ingenious but incredible, and justify a search for an alternative and simpler explanation*" (p184).

There is agreement that "*the British Neolithic seems to be a hotch-potch of different traits that can be derived from a large expanse of the coastal hinterland from Jutland to Brittany*" (Dennell 1983 p182). While those supporting the colonist model must seek some way to explain this, the evidence seems to fit more easily with the acculturation model. Piggott (1972) states that the British Neolithic involved "*the transmission only of selected features from the rich complex of traditions presented by the TRB cultures...not the acquisition of the culture as a whole*" (p229), though he does not acknowledge it, this is characteristic of the acquisition of traits by acculturation. If the Mesolithic population copied or imported certain aspects of the Neolithic culture, as they appear to have done in Southern Scandinavia (Price and Gebauer 1992), an eclectic mix, with few exact parallels would be expected. This acquisition or copying of Neolithic artefacts may have occurred within existing ritual structures, in a similar way to modern cargo cults (Ashbee 1982). Monuments, pottery and other items might be made in imitation of ones seen on the Continent, producing a general similarity, but differing details, or even a complete change in function of the copied item. While adoption of Neolithic culture seems to have been eclectic, there is no evidence that different traits were adopted at different times as in Denmark (Bradley 1984). Either these characteristics represent a process radically different from that occurring elsewhere in Europe, or there is a gap in the British evidence, and the early Neolithic is equivalent to the rapid substitution phase in Denmark (Zvelebil and Rowley-Conwy 1986). Variations in forms do not necessarily have to be explained as inaccurate copies or degenerate forms of an original. Fleming (1972b) stresses that even in the prehistoric period objects and monuments were deliberately designed to fulfil certain functions. If materials or functions changed the design might be deliberately altered to accommodate this.

The Channel must have played an important role in the introduction of agriculture to Britain whether as a barrier or a communication route. In the case of immigration it would have posed a considerable barrier for large scale settlement, but in

either case most domesticates must have been physically imported until breeding stocks were established. The method of crossing the Channel with livestock is problematic. Case (1969) believed that cattle could not swim Channel even towed, and boats must have been used. A skin boat may have been practical for Channel crossing, but Noddle (1989) claims that a cow trussed up on its side in a boat would probably not survive the journey. Cattle were transported in skin currachs on short sea voyages in recent times in Ireland (Ryder 1983), and forced to swim behind boats between islands in the Hebrides, but the Channel is a more serious proposition. Noddle can only suggest that the warmer climate and fewer storms of the Atlantic period might have made the crossing easier. The Channel was narrower than today, but probably had dangerous tidal races (Case 1969). Despite the difficulty of transporting livestock Case (1969) proposed the seasonal grazing of cattle in Britain by a Continental group, though (Wilkinson 1971) claims that domestic cattle could be left over winter without becoming feral. A gradual process of familiarisation and establishment of herds and crops might have reduced some of the risks of pioneering communities, but the close ties with the parent community would result in close similarities of culture, that clearly are not seen in Britain. It also fails to explain the motivation for this move, as Bradley (1984a) sees insufficient evidence for population pressure at the relevant period on the Continent so competition for new land in northern France seems unlikely.

Case's stress on the use of boat transport by Continental farming groups has been criticised. The Continental Neolithic was land based, there was little need for them to use boats, except for transport along rivers, and it seems unlikely that they would have sufficient skills in sea travel, or reason to become sea farers. Alternatively there is evidence for Mesolithic sea faring: the colonisation of islands round Britain, including Ireland; deep sea fish on the Oronsay and Morton middens, Scotland, and Norwegian Mesolithic rock carvings showing seal hunts (Dennell 1983). Though most of the fish on the Oronsay middens are saithe and could be caught inshore with traps (Mellars 1979), but large cod came from Morton, and large specimens of this species cannot be caught inshore (Coles 1971). Case (1976) agrees that the Mesolithic people were likely to have spread Neolithic traits up the Atlantic coast of Europe by boat, and they seem the most likely candidates for transporting livestock and seed corn across the Channel. Clark (1980) suggests the importance of fishing in the early spread of cultural traits, as it attracts people further from home, giving them the possibility to experience more distant cultures. Broodbank and Strasser (1991) argue that Neolithic marine colonisation is not a natural extension of hunter-gatherer marine strategy because of the difference in the tasks the boats had to be designed to do. Hunter-gatherer boats would be light and easy to handle, whereas farming colonists needed water tight boats capable of transporting large and

awkward cargoes. This ignores ethnographic records of hunter-gatherers possessing different boats for hunting and transporting bulk items; existing Mesolithic trade networks may have demanded bulk, dry transport of goods by boat.

If the British Mesolithic people are to be seen as the main force behind the introduction of agriculture, their isolation from Continental groups must have ended and their exchange networks extended. Bradley (1984a) sees the concentration on coastal resources as important, as more sea going activities could extend exchange networks, and bring knowledge of new cultural ideas. In particular fishing of migratory fish provides stimulation for creation of an extended "*maritime interaction sphere*" (Jacobi 1987 p167). Bradley suggests that there was an increase in dependence on coastal resource^s from about 4000 bc which resulted in contact being established with the Continent, involving long distance alliances from France to Scandinavia stimulating the adoption of new artefacts, monuments and ideas. Hunter-gatherers' subsistence patterns demand that they be flexible and ready to form external alliances. They may have been less insular than farmers, and more ready to pick up new ideas, once contact with the Continent had been made (McIntosh 1986). The processes of exchange, and the acquisition of new prestige goods could have disturbed the political balance of the British Mesolithic sufficiently to encourage competition and make the production of a surplus, best achieved by adopting agriculture, desirable. Piggott (1979) points out the "*imprecise*" nature of our knowledge of late Mesolithic groups on either side of the Channel. This knowledge has not greatly improved in recent years, and makes cross Channel contact, or even sea-going activity difficult to demonstrate.

2.2 Anthropological comparisons and insights

2.2.1 Introduction

Many of the above models are based to some degree on concepts developed by the discipline of anthropology. Though European archaeology, particularly British archaeology, has tended to prefer alliances with the biological and hard sciences, rather than with anthropology (Rowlands and Gledhill 1977, Groube 1977), current theories in anthropology do influence archaeological thinking, especially in reference to hunter-gatherers. American archaeology has had a much closer relationship with anthropology (Groube 1977), and has played an important part in introducing anthropological theory into archaeology.

The perception of hunter-gatherers, both ancient and modern, has changed significantly since the Man the Hunter conference helped to destroy their passive, wretched image (Lee and Devore 1968). The views expressed there had an important influence on interpretations of the Mesolithic/Neolithic transition. However, the influence of anthropology tends to be covert, and not adequately discussed in much of British prehistoric archaeology. There is a general change of opinion, but articles only quote a few, well known references in support of their revised hypotheses. British archaeologists generally seem reluctant to use anthropological data in the construction of their theories, as there is a tendency to consider insights about peoples living in vastly different times and conditions, to be irrelevant to British prehistory (Clark 1975). The *"suspicion of the validity of chronologically and culturally remote ethnological analogies is justified"* (Groube 1977 p70), but anthropology has more to offer archaeology than spurious, direct analogies.

Perhaps the term 'anthropological parallel' is misleading. The fact that people carried out a certain activity in a certain way at one point in space and time, does not suggest they did so during a period of British prehistory. Such data is rightly criticised, as it cannot be used directly to support a theory. However, the alternative usually presented is an attempt to interpret the archaeological record entirely without the help of anthropology, relying instead on our modern experience, and imagination. This appears to me to be equally unreasonable. Most British archaeologists have no experience of hunter-

gatherer and "primitive"⁹ farming life styles, and even our imaginations are limited to a large extent by our cultural context. What anthropology offers archaeology is examples of *"the variety and complexity of the human solutions to survival in analogous situations"* (Groube 1977 p87). These examples have the advantage over imagined ones in that they have proved to be practicable, at least in the environment in which they were observed. Anthropology can provide the data needed to create theories, that can be tested against the archaeological data.

Ethnographic examples can be used to highlight problems in the archaeological record, and their possible solutions (Coles 1976). This is most simply applied to technology, where functional criteria are important. Anthropology can suggest a probable function for a tool, and tests can be carried out on the archaeological material to establish whether the theory fits the evidence (Fletcher 1977). At more complex social levels it may be possible to suggest trends common to groups in many different situations. The development of this approach into the creation of universal rules seems unlikely, as there are too many potential exceptions to even simple rules (Fletcher 1977, Leach 1977).

The limitations of anthropological evidence in relation to archaeology must be recognised. Most modern, small-scale societies have been forced into marginal environments by agriculturalists, whereas most ancient, small-scale societies lived in optimal environments (Lee and DeVore 1968). Before the spread of agriculture most hunter-gatherers must have lived in fertile, well-watered areas, with differing degrees of seasonality. Therefore, the present cannot be expected to supply the full range of variation that might have existed in the past (Price and Brown 1985), and archaeologists are likely to discover cultural traits of which anthropologists have had no experience (Fletcher 1977).

The use of ethnographic data from groups in similar environmental conditions to those studied by archaeology will increase the likelihood of comparability, but similarity of environment does not, necessarily, mean that cultural choices will be similar. Even if archaeological and ethnographic data appears the same it cannot be assumed that they are the result of the same processes, as other processes might also produce the same effects. The Mesolithic of Britain, with its temperate, highly seasonal climate, finds its closest parallels in the high latitude hunter-gatherers round the north Pacific, though comparisons are far from exact. As similar environments are no guarantee that two societies will behave

9. The term "primitive" is used in quotation marks because it describes simply and concisely peoples having minimal contact with market economies and complex political structures. However, it implies certain evolutionary and value judgements that cannot be made without detailed study of particular societies. I do not intend to imply any of these.

in a similar way, there is no reason to limit the search for models of change solely to groups living in comparable conditions.

A literature search of anthropological studies related to hunter-gatherers and 'primitive' farmers has been included in this study to investigate the ideas behind models of the Transition, and perhaps suggest new approaches to the issue in Britain. The 'anthropological' data discussed below also include archaeological data from times and cultures quite different to those I am studying. This evidence is subject to the usual vagaries and problems of interpretation that ^{of}inflict all archaeology, but helps provide the same broad and diverse perspective that the anthropological data does.

2.2.2 Views of hunter-gatherers

The perception of hunter-gatherers by anthropologists, in general, is important in defining what questions are asked about the change to farming in the past. From the 1900's to the 1960's hunter-gatherers were seen as the first stage in human evolution (Bettinger 1987). They tended to be depicted as primitives, and defined by what they had 'failed' to achieve: agriculture, polished stone tools, social hierarchies, etc. They were perceived as being outside history, and completely untouched by the passage of many millennia (Hamilton 1982); fossilised remnants of the Palaeolithic, preserved because of isolation from trade routes of foreign powers (Headland and Reid 1989). Why the change to agriculture occurred, was not considered to be a question, because it was seen as the next obvious, developmental step.

The concept of pristine cultures is now largely discredited among anthropologists, and there is an increasing trend to consider the historical dimension of cultures studied (Solway and Lee 1990). This has revealed considerable change within these supposedly unchanging cultures. Modern cultures cannot therefore be compared to ancient ones merely by claiming they have been unchanged since the Palaeolithic, and so continue to do things as they were done then. It is possible that "primitivism" may not even be a real evolutionary stage, but caused by other factors, such as the adaptation of societies to marginal environments (Rowlands and Gledhill 1977, Fletcher 1977).

Ethnological studies of the 1960's helped to change the perspective. Hunter-gatherer behaviour was viewed as being adaptive and homeostatic (Bettinger 1987). Even in hostile environments these peoples were demonstrated to live well without expending much effort in the food quest (Lee 1968). Lee did point out that groups living at high latitudes were unlikely to have such an easy life, but the concept of original affluence

developed by Sahlins (1968, 1974) coloured most generalised views of hunter-gatherers. Later comparison of theory and data demonstrated that not all cultures fit the more extreme, original affluent society model particularly well (Bettinger 1987). The data on which Sahlins based his ideas was not of the best quality, and more recent studies have shown that even the !Kung of the Kalahari actually work an average of 6 rather than 2 to 3 hours a day (Bird-David 1992a). Sahlins theories also apply only to immediate return economies, and are of limited value to European prehistory. However, he, and others expressing similar ideas, did help change attitudes, and made explanations necessary for the conversion to agriculture of groups well adapted to their environment.

More recently discussion about complex hunter-gatherer groups has broken down the "*Great Divide*" between hunter-gatherers and farmers, showing it to be more of a "*graduated continuum*" (Hamilton 1982 p232). The step between a complex hunter-gatherer group and an agricultural one was small, but the motivation for taking that step, instead of continuing with efficient traditional methods, still required explanation. At present both hunter-gatherers and agriculturalists tend to be perceived as a product of adaptation to specific environments, and the influence of recent and ancient history (Solway and Lee 1990). "*Small indigenous societies are as fully modern as any twentieth human group*" (Headland and Reid 1989 p51), and hunter-gathering is seen as the most viable adaptation to marginal environments.

The view of hunter-gatherer society as conservative and unchanging is also being modified. Evidence for outside influence on groups previously thought to have been isolated, is being extended back long before nineteenth century colonialism (Wilmsen and Denbow 1990). Most "isolated" groups have been in contact with other peoples, often for thousands of years. The hunter-gatherer Negritos, of the Philippines, have been in contact with agriculturalists since the latter came to the area around 3000 BC, and were part of the Chinese trade system possibly as early as the 5th century AD. This has only recently been discovered, and they had been portrayed in the anthropological literature as a classic example of an isolated, pristine people (Headland and Reid 1989). Even the San, archetypal hunter-gatherers of the Kalahari, are having their unchanging nature questioned. Archaeological and historical evidence has shown that the Dobe !Kung have "*played an active part in regional, and even world, socio-economic systems*" (Bird-David 1992b p20). References to San people drinking fresh milk occur in the literature, and Casimir (1990) has questioned how this is possible if they had not been herders at some time, and acquired lactose tolerance. In some groups, e.g. the Maori of New Zealand, characteristics thought to be ancient have been demonstrated to have been recently acquired due to contact with European colonists (Leacock 1991, Groube 1977).

2.2.3 Relations between hunter-gatherers and farmers

It is difficult to find modern parallels for the early adoption of agriculture by hunter-gathering groups. The majority of modern hunter-gatherer groups are located on marginal land not suitable for agriculture. Their adoption of farming is often forced on them for political reasons, rather than representing a viable economic or social choice by the group. Comparisons with present agricultural societies are not particularly helpful either. The simplest agricultural societies are in areas with vastly different climates and vegetation to Britain. Most are either very old, and the reasons for their adoption of agriculture are as obscured by time as the British cultures, or modern politics and economics have had a major part in the change. Coles (1976) has drawn comparisons between the European pioneer farmers in Canada and the European Neolithic. In Canada farmers practicing slash and burn agriculture crossed large areas in a single life-time. They produced small clearings, which would have been difficult to detect in the pollen record, and built log cabins, whose foundations would not survive in the archaeological record. This is an example of the rapid spread of farming by an archaeologically invisible pioneering phase, not unlike that often proposed for Neolithic Europe. However, the North American pioneers are a poor parallel because they were part of an expanding global economy, fuelled by the demands of industry for raw materials, and luxury goods. Neolithic colonisation was on a much smaller scale, with limited technology, and no market economy (Gregg 1988).

Most modern hunter-gatherers live in marginal environments, and agriculture generally affects them in negative ways, causing the over-exploitation of delicate environments, and the loss of traditional resources. Relationships between foragers and farmers are likely to have been very different in prehistoric, temperate Europe. Dennell (1984, 1985) and Gregg (1988) have listed a variety of possible relations between the two groups, but anthropology can provide other examples, with the added advantage that their details can be studied in the field.

Competition and conflict between hunter-gatherers and farmers may arise, as in southern Africa where the hunters raided the farmers livestock, and the farmers hunted the hunters (Inskeep 1978). Alternatively hunter-gatherer groups may be well aware of the advantages they can obtain from agricultural groups, and may cultivate an amiable relationship. Fleisher (1984) describes the response of the Makah of Washington state to European colonists. The Makah had a complex social organisation, with permanent villages and three social classes, based on a largely marine economy. Competition, rivalry and acquisition of prestige were of considerable social importance, and the chiefs of the

Makah saw Europeans not as a threat, but as an opportunity to increase their prestige. In this case, though the pressure to assimilate came largely from the Makah, the whites did not deliver their promises, and it resulted only in the destruction of Indian culture. Perhaps in a situation where the two cultures were technologically more equal the hunter-gatherers could assimilate aspects of the new culture, dramatically changing their own, particularly in ways that represented an increase in prestige for the group leaders.

There are ethnographic records of more equal and mutually beneficial relationships between hunter-gatherer groups and agriculturalists. Cashdan (1986) describes the Bateti who live on the flood plain of the Botletli river, Botswana. Their rich environment allowed them to live fairly settled lives, and they developed some social stratification, in the form of village headmen. The Bateti had concepts of land ownership, possessed valuable land, and had leaders to speak for them; enabling them to negotiate when small groups of Bantu herders arrived in the area. The Bantu groups were too small to take land forcibly, but were given it by the Bateti, allowing harmonious relations between the groups. As more Bantu arrived land became scarce. Too little land was left for the newcomers to grow enough grain, and they had to purchase grain from the Bateti, in return for cattle. In consequence while other hunter-gatherers in Botswana were forced to herd Bantu cattle when their traditional resources were depleted, the Bateti had become wealthy cattle owners in their own right. Thus significant economic, and presumably also social change occurred in the Bateti culture through amiable relations with the herders.

The Mbuti pygmies appear to trade with neighbouring farmers largely to make it unnecessary or them to enter the forest to collect forest products for themselves. Though the Mbuti enter the farming villages and often work there, the farmers have no need to enter the forest. Their fear of Mbuti and forest magic also work to keep them out of Mbuti territory, without the need of violence. Despite significant contact between the groups they remain distinct, and the Mbuti appear to be economically independent of the farmers (Turnbull 1983), though this has never been demonstrated (Headland and Reid 1989).

The Indians of the Chaco, Paraguay, are greatly affected by the modern culture of the country, but have retained a strong egalitarian ethic and essentially hunter-gatherer world view. Despite the numerous opportunities for developing inequality, these do not seem to have been taken up (Renshaw 1988). It would seem that even if groups are forced to merge economically and politically, full cultural change will not necessarily occur. Rapid and complete cultural change would seem to be facilitated by the desire of the group involved for this to happen.

Though such examples seem almost anecdotal, the aim is not to construct some theory based on spurious statistical likelihood, but to present a wide variety of alternative ideas. Ethnology frequently demonstrates the complexity of relationships between groups and various aspects of their cultures. The Transition from hunter-gathering to agriculture is often discussed in economic terms, yet in Britain it seems to have involved an equally dramatic change in social traditions and material culture. Anthropological data allows archaeologists to consider this social and ideological sphere, and possibly create hypotheses that are archaeologically testable.

2.2.4 Complex societies

As it is almost impossible to find modern examples of the adoption of agriculture, and a large proportion of anthropological studies are based on hunter-gatherers, it seems most productive to concentrate on hunter-gatherer groups in environments similar to Mesolithic Britain. Some trends common to these groups may suggest ways to approach the British problem.

One of the most discussed complex hunter-gatherer groups are the Indians of the north-west coast of North America (Renouf 1984, Suttles 1968). The social complexity of these groups have been known for a long time (Jewitt 1824), but more recently they have been incorporated into general theory about hunter-gatherers, and are no longer considered exceptional. Other groups at similar latitudes have also demonstrated similar social complexity, especially the Ainu of Japan (Watanabe 1968, 1984), and these seem to be much more reliable parallels to the British Mesolithic, than the tropical hunter-gatherers. There seem to be pre-requisites for the adoption of agriculture, which most simple hunter-gatherer do not possess, while the nature of the environment at higher latitudes demands certain complexities, such as delayed return collecting systems and storage technology.

Social complexity has a variety of definitions depending largely on the field of interest of the author. In specific relation to hunter-gatherer groups there is some consensus over its characteristics. Complex societies can be recognised by the following features (Ames 1985, Brown 1985, Cohen 1985, Gamble 1985):-

1. The emergence of social differentiation, which may be reflected in burials.
2. Increased intensification and storage, including the conversion of food surplus into durable goods.
3. Increase in the size of the domestic unit and permanence of settlements.
4. Increased elaboration of material culture, craft specialisation, the construction of monuments etc.
5. Development of inter-regional exchange networks.

Ames (1985) suggests an increase in logistical organisation might be necessary to improve the efficiency of resource exploitation. This might be represented in the archaeological record by the increased differentiation of site function and location. Cohen (1985) lays more stress on the increased formalisation of social relationships, which stimulates a demand for luxury goods to symbolise social position. Brown (1985) emphasises that all these factors are mutually reinforcing, developing together to form the complex society. Various levels of complexity grade into one another, and it is hard to define critical points in the development of complexity. However, there is no evidence that complexity develops without some stimulus to do so, and there must be some stress on the previous system to initiate change (Neeley and Clark 1990).

Simple, mobile hunter-gatherers solve social problems by fission; individuals can easily leave a group and join another, or form their own, if conflict arises (Lee 1972). Aggregations create problems that do not occur in small, mobile groups, but may be unavoidable in some circumstances (Cohen 1985). Fission might not be a feasible means of settling conflicts where the population is concentrated in a limited area by physical relief, the distribution of resources, or strictly enforced territory boundaries, or where there is considerable investment in equipment or stored produce (Spence *et al* 1984). In which case it seems likely that new social structures would be necessary to cope with problems related to the stress, confusion and inefficient communication associated with larger groups of people (Cohen 1985). These problems can be relieved for short term aggregations by the use of ritual to reduce the communications load and define relationships, and through sequential hierarchies, but social complexity seems to evolve to cope with long term stresses (Cohen 1985). Ames (1985) argues that hierarchies are more efficient at processing information, and increase efficiency in decision making, thus they are an advantageous adaptation in situations where long term aggregations are necessary.

Dunn (1968) contends that complex hunter-gatherer systems are less stable than simple ones, because small territories suffer greater fluctuations in yield than large ones, and the greater degree of scheduling and organisation of labour means that there are many more things to go wrong than in a simple society. On a world-wide scale complex societies appear, in the archaeological record, to have lasted a relatively short time, often preceding agriculture. They are more vulnerable to disruption by fluctuations in resources, population growth, and social conflict. Exchange with other communities helps reduce risk, but may stimulate inequality, and social stratification resulting in a greater complexity (Henry 1985). Social complexity seems to have occurred during the Upper Palaeolithic. In Russia it may be represented by mammoth bone houses, storage pits, art, and very long distance trade (Soffer 1985). The development of social complexity in later periods, therefore, probably had earlier precedents, and was not a particularly unique and extraordinary occurrence.

2.2.5 Impetus for change

For hunter-gatherer groups to adopt agriculture certain pre-requisites would seem to be necessary, many of which also define complex societies. They require techniques for efficient gathering and storage of plant foods, a broad spectrum economy, and though sedentism is not essential for agriculture, it would seem to make the adoption of farming easier (Kabo 1985). Perhaps more importantly hunter-gatherer societies need an impulse to change. Explanations for both increased social complexity and the adoption of agriculture, often involve similar factors, and would seem to be in some way related. Explanations for social development and change are varied, and inevitably, a single explanation for all instances is not possible. The sequence of causality in a process of transition is often difficult to determine from the archaeological record; e.g. whether storage causes sedentism, or *vice versa*, and whether either can cause social complexity. This section reviews some anthropological theories of what causes hunter-gatherer groups to change and develop more complex social structures, and in some cases agriculture.

2.2.5.1 Physical and economic factors

Environment

Environmental changes have been used to explain the appearance of social complexity throughout prehistory, such as in the Upper Palaeolithic of south-west France (Mellars 1985), or the Natufian of the Levant (Henry 1985). However, the over-whelming

influence of the environment on hunter-gatherer populations is coming increasingly under question. Hitchcock and Ebert (1989) point to the "*incredible continuity*" (p49) found in the archaeological record of arid land communities, despite considerable environmental change. Also significant social change occurs despite environmental stability. There is no significant environmental change that can be detected at about 2000 BP on the north-west coast of North America, when the people there began economic intensification and increased their social complexity (Lazenby and Cormack 1985, Ames 1985).

Richardson (1982) collected ethnographic data which suggested some correlation between the abundance of resources and the degree of social complexity, as measured by ownership rights and social stratification, in recent groups along the western coast of North America. It appeared that where resources are abundant there was less emphasis on ownership, and the emphasis increased as resources became scarcer. When resources became very scarce groups seemed to become simpler in social organisation, and to share resources. The environment seems to provide a potential for complexity, and to control how much it will be expressed, but there is no evidence for it causing complexity.

Bender (1985) stresses that subsistence type does not dictate social type; the adoption of agriculture does not inevitably bring the social complexities seen in the European Neolithic, and similar cultures can develop without agriculture. Social changes in early and mid Hopewellian culture of middle North America were assumed to be associated with the introduction of agriculture, but evidence suggests maize was not grown in economically important quantities. Squashes were cultivated, but probably only for containers. Agriculture was therefore small-scale, and the economy still based on hunting and fishing. However, there was an increase in settlement permanence, social differentiation, and monument building (Bender 1985). It therefore seems that explanations for changes in social complexity, or for the adoption of agriculture are unlikely to be related to simple economic responses to environmental change. Environmental change has been proposed as an important factor in increasing social complexity and the adoption of agriculture in Mesolithic Europe (Zvelebil and Rowley-Conwy 1986, Nygaard 1990). These models need to be seen within a more complex definition of environment, which includes social and cultural factors, as well as physical ones.

Population

Population pressure is another frequently used explanation of all types of social and economic change. Population pressure has the potential to stimulate social complexity. A higher population density can result in social and economic change, competition and warfare that could have caused social complexity (Ames 1985). However, as discussed above (p14), population changes are very difficult to determine from the archaeological record, so the actual existence or influence of population increases can rarely be determined.

It is necessary to explain the reason for an increase in population density in any particular area. One model suggests that once a population enters a new area it increases rapidly to occupy all available environments, then stabilises, and is maintained in equilibrium with the environment. This fails to explain how further changes occur, and requires a dependence on external factors to explain changes in population density. However, no population can be in perfect equilibrium with its environment, and fluctuations in density must have occurred throughout human prehistory, some with possibly serious consequences in localised areas. As many cultures seem to have remained unchanged despite population fluctuations, population density alone may not be adequate to explain social change (Lourandos 1979).

Cohen (1977) uses a variation of the above model to explain the roughly simultaneous appearance of agriculture across most of the world. He assumes a steady rate of population increase across the world, which resulted in the carrying capacity of the environment in many places being reached at much the same time. In Cohen's model the human population would not then stabilise, but intensify its production, often by the development of agriculture, to support an ever larger population. However, in prehistory world population densities were of no significance, and there is no reason why local densities should increase at the same rate in very different environments (Bronson 1977). There is also little evidence for especially high population densities in many places where agriculture was developed or adopted. Deith (1989) claims there was a gradual population growth throughout the European Mesolithic, which curtailed mobility and encourage sedentism, but there is little real evidence for this. Bender (1978) claims that there is no evidence from any source for population increase before agriculture or sedentism. Population increase therefore seems more likely to be a consequence, rather than a cause of social complexity, but it could be important in stimulating further complexity.

Inevitable population increase is rarely assumed today. As far as can be determined, simple hunter-gatherer populations seem to be fairly stable. Lee and DeVore (1968) claim a 15-50% rate of infanticide in the past maintained hunter-gatherer populations at the desired level, but authors present little evidence for this. Even without deliberate control of population numbers natural factors, such as fertility varying with age, birth spacing, lactation, and mortality, tend to result in a stable population (Wood 1990). Many of the factors associated with social complexity can also result in population increase. Sedentism reduces the problems of caring for more than one infant at a time, which are significant in a mobile society, where infants have to be carried. Breast feeding generally continues until the child can walk on its own, reducing the chances of further pregnancies. This method of contraception only seems to work well when the mother's fat level is low. Sedentism tends to make both sexes fatter, and traditional forms of population regulation may cease to work. The period of lactation can also be reduced where suitable foods, such as cereal mash, enable early weaning (Reed 1977). Intensification of production may demand more labour, and children can be an asset, even a method of producing wealth. However, there is some evidence that the wide birth spacing of hunter-gatherers actually maximises population growth, and while a broad spectrum diet leads to improved reproductive success by encouraging sedentism, and improving nutrition, it seems to result in a decrease in population growth (Hawkes and O'Connell 1991).

Storage

The relative importance of storage is often seen as a major distinction between simple and complex hunter-gatherers. Binford (1980) has defined the foraging system common among the mobile, simple hunter-gatherers of the tropics and sub-tropics, as opposed to the collecting system typical of higher latitude groups. Foraging is an immediate return strategy where there are seasonal residential moves among resource patches, and food is not stored, but is gathered daily. The collecting system is characterised by storage of food for at least part of the year, in order to survive in highly seasonal environments. It involves logistical organisation as food resources are often widely distributed. A base camp is located near one critical resource, usually the most predictable one, and other resources are exploited from temporary camps, involving the movement of small groups or individuals, not the whole residential group.

The collecting system involves delayed returns on investment. Food may be stored, and not consumed immediately; time and labour may be expended on planning, information gathering, and the construction of equipment, such as traps, with no immediate return in the form of food. This delayed return on effort expended, and the

need for storage and planning, makes groups functioning by this system very similar to simple farmers (Hamilton 1982). There is no reason to suppose an evolutionary relationship between foraging and collecting systems. They are two parallel adaptations to very different environments. Logistic strategies are common in mid and high latitudes because of the high seasonality. The scarcity of food resources during the lean season necessitates storage. Storage requires logistic mobility and tends to concentrate settlement near the stores (Ames 1985).

Storage can be important in social terms. Reliance on stored food for part of the year allows time for the practice of ceremonies, and increased social complexity. It increases the minimum food supply in the leanest season, so a larger population can be supported. In certain circumstances it can be relatively easy for surplus stores to be appropriated by incipient hierarchies, and used to create power through exchange (Testart 1982). However, *"the great majority of contemporary hunter-gatherer societies....conform to....delayed return systems"* (Ingold 1983 p554); even mobile groups store food to some extent. Storage in itself is not the cause of demographic concentration, sedentism or trade, but it is demanded by these activities, and is a precondition for them. Storage is not contradictory to food sharing, and egalitarianism. Often stores are used only by the household when there is plenty, but are shared when another household has run out of stored food (Ingold 1983). Storage for winter can be an important part of a sharing economy, and does not represent intensification, which is defined by the production of a genuine surplus (Ames 1985).

The domestic mode of production (as defined by Sahlins 1974) is geared towards self sufficiency of the production unit, usually a household. If technological advances increase the efficiency of production, leisure time tends to increase rather than productivity. Social and political pressures from outside the domestic unit are necessary to stimulate intensification and increased productivity (Sahlins 1974, Ames 1985). This increase in productivity is associated with the perception of goods as wealth, the symbolic demonstration of social status, the ability of a population to increase, and other characteristics of complex societies. Agricultural societies, as well as hunter-gatherer ones, can be simple, with minimal social hierarchies, and in both cases some change is necessary to intensify the domestic mode of production, and cause the expression of complexity.

In recent North West coast societies there seems to have been a correlation between the diversity of food stuffs stored and social complexity (Ames 1985). Hierarchical leadership is necessary to co-ordinate the complex procurement and

processing strategies associated with exploiting a wide variety of foods. In this case it seems that it is not the appropriation of stores that results in social complexity, but the need to acquire enough of the right foods to make up the stores in the first place. Consumption delays and logistical strategies are important in the development of vertical hierarchies (Ames 1985), but they tend to act in subtle ways varying in accordance with numerous other factors.

Sedentism

Agriculture is not a pre-requisite for social complexity, as was once thought; hunter-gatherers cultures can be as complex as farming ones (Oberg 1973, Sheehan 1985, Spence *et al* 1984). Sedentism seems to have taken the place of agriculture as the key to cultural complexity. Sedentism requires intensification of resource exploitation, often involving more complex storage techniques, and the exploitation of a wider range of species. It is not inevitably beneficial, and there must be a motivation for its development. The most common explanations put forward are (Brown 1985):-

1. Environmental stress: shrinkage in the resource base may make a mobile foraging strategy less viable, and intensification of exploitation of resources in a more restricted area becomes necessary.
2. Abundance: certain areas may have such an abundance of resources that there is little need to move elsewhere.
3. Demographic change: intensification may be needed to support an increased population, but reasons for population increase are often difficult to determine, and this often seems to be a result not a cause of sedentism.
4. Reduced mobility: mobility may be limited by the territories of other groups, or because of natural factors, demanding intensification of subsistence.
5. Social: the need for a mating network, protection against hostile groups, and help in times of shortage may encourage aggregation, economic intensification, and sedentism.

These are notably similar to factors claimed to cause social complexity in general, and in many cultures sedentism and complexity seem closely interlinked. Changes in mobility patterns occur in present day hunter-gatherers due to fluctuations in resources.

Sedentism might occur when a series of these adjustments are all made in the same direction (Brown 1985). Alternatively it could be caused by the need to stay near large scale stores of food to defend them, but it could develop in non-storing economies, if varied food sources were accessible from one base camp (Testart 1982). The vertical distribution of diverse ecological zones in a narrow area e.g. in mountainous country, allows high residential stability. Temporary hunting sites can be used to exploit more distant resources, while a base camp is located near reliable plant or fish resources (Watanabe 1968).

While sedentism bestows certain advantages it also has considerable disadvantages; the former must outweigh the latter for sedentism to be a viable alternative. Permanent buildings cost more in labour and time to build than temporary huts, though once constructed maintenance may be minimal (Reynolds 1987). Permanent settlements have a much greater risk of disease than small, mobile settlements, and stores may be stolen by neighbouring groups if not well hidden or defended. Stored food may also be lost to rot or pests. The dependence on a small territory and small range of food leads to increased vulnerability to famine. The harvest of seasonally abundant resources, wild or domesticated (e.g. salmon or cereals), mean the work load is unevenly distributed throughout the year (Bender 1978). Sedentism is essentially an aspect of social complexity, rather than a primary cause, and its causes need to be explained.

Modern examples of hunter-gatherers becoming sedentary are generally due to political or economic compulsion, but they do indicate the variety of changes that follow sedentism. In the Kalahari various changes in the physical and social environment have caused many of the hunter-gatherer groups to become more sedentary. This has produced many changes. Decreased mobility reduces the need for long birth spacing, so increasing the birth rate, though it may also significantly increase the infant mortality rate. The nature of reciprocity changes with sedentism, and differences in wealth can appear leading to economic and social stratification (Hitchcock and Ebert 1989). The Indians of the Columbian Plateau had winter villages, the location of which was stabilised by the presence of stores, rights to local resources, and the construction of substantial houses. In archaeological terms these settlements would appear indistinguishable from permanent settlements, though most of the population vacate the winter villages for three seasons of the year (Nelson 1973).

Occupational differentiation

Once sedentism has developed, for whatever reason, the problems of long term aggregations, and increasingly complex logistical strategies could cause the change to a hierarchical social structure. However, Watanabe (1988) claims that there is no evidence in the anthropological data for a close relationship between storage, sedentism and inequality. He suggests that neither storage nor sedentism inevitably causes inequality, but that it is automatically caused where there are occupational differences between adult males.

The specialisation of males of one family in a different occupation to males of another family is characteristic of Arctic and sub-Arctic hunter-gatherers, but is not seen in low latitude groups. It occurs where there are two important food sources that are abundant at the same time of year, or are located in very different areas. To exploit both resources simultaneously a division of labour is necessary. A similar problem faces low latitude groups, in that both plant and animal foods are important, and labour differentiation is necessary to exploit them simultaneously. In this case the division is normally between the sexes. At higher latitudes plant collection is less important, but women are normally fully employed in processing and storing food, so further labour division cannot be purely on lines of gender.

In many groups a division develops between men predominantly involved in hunting, and those who are mainly fishers. In human society differences are frequently interpreted in terms of superiority and inferiority. Hunting generally retains its superior status, because it is perceived as requiring more training and bravery than fishing. The hunters acquire the most prestigious rituals, and become, to varying degrees, an upper class in society. The fishers must therefore form a lower class. This simple social organisation, combined with the need for storage in highly seasonal environments, often produces concepts of wealth in these societies. Among the Ainu and the groups of the North West coast these differences became well defined, and enshrined in the structure of society. The class structures of these societies were generally fairly flexible, and movement between different classes was possible, largely on personal merit (Watanabe 1984). Economic necessity thus can supply an automatic hierarchy, which could be enhanced by exploitation of stored produced, and acquiring control over external exchange.

2.2.5.2 Social factors

Renfrew (1973) sees the dictatorship of the environment as a concept, which may be applicable to animals, but not to humans, with their ability to create "*a hypothesis of reality*" (p471). He perceives this ability to imagine an ideal world as the major motivation of cultural change. The environment of any individual or group includes other people as much as the physical environment, and the former may be more influential than the latter. It is also important how an individual or group perceive that environment, and how their existing culture and history defines the range of choices they have for the future (Ellen 1977).

A group's perception of the environment can significantly influence the way they respond to changes in that environment. According to Bird-David (1992b) the sharing economy of immediate return hunter-gatherers controls how they perceive their world, and is a major force that reduces motivation to innovate, but makes them particularly quick to accept new items when these are presented from outside. The social attitudes of these groups towards sharing produce both conservatism and flexibility, helping to explain both social stability and change. The delayed return foragers of Mesolithic Britain undoubtedly had a different outlook, one more similar to the farmers. However, if the willingness of "primitive" societies to accept new ideas could be derived from an essential part of their traditional culture this may also apply to more complex groups. If left in isolation the Mesolithic populations of western Europe may never have invented agriculture, but that does not mean that once presented with the idea and means, they did not actively perceive its benefit to, and place within, their own society.

A broad spectrum economy is often assumed to be a pre-requisite for adoption of agriculture, and the attitude of those possessing this type of economy might encourage the adoption of agriculture, without the need to invoke a subsistence crisis. The benefit of a broad spectrum diet is that search time is minimised, where resources are abundant this can increase calorific gains even when resources of low nutritional value are exploited (Hawkes and O'Connell 1992). The husbandry of domestic cattle has similar benefits; domestic cattle can turn plants of low calorific value into milk and meat, which can be collected with minimal effort. Milk from domestic cattle could also increase the variety of an already varied diet, rather than merely replacing wild game species (Hawkes and O'Connell 1991).

Economic and technological change may actually be motivated by social factors, rather than merely being facilitated by them. Roscoe (1989) shows the spread of a type of yam in New Guinea to be related to ideals in ritual symbolism, and to political stability.

Ethnographers have recorded different population densities in very similar ecological areas of Australia, suggesting that social mechanisms might be seen as a force for change. "*Competition, no matter how subtle, existed in hunter-gatherer societies*" (Lourandos 1979 p257), but the competitive nature of hunter-gatherer society has largely been ignored by anthropologists in favour of a theory of egalitarianism. It seems possible that competition with neighbouring populations could drive population, technological and social change.

Exchange

Small groups must have external contacts as they cannot supply enough marriage partners from within the group. Even in larger groups the genetic problems of inbreeding make the choice of marriage partners from a larger population desirable. Long distance connections insure against local resource failure, providing kin to visit, or goods to exchange, if local resources fail. They also provide access to resources not locally available. Social networks are maintained by exchange and obligations. These networks can be very large, and are represented archaeologically by the goods transported along them, e.g. in California shell "money" could travel 1000 km (Bender 1978). Long distance networks can exist in mobile, immediate return hunter-gatherer cultures, such as the Australian aborigines. Exchange does not inevitably cause complexity, but under specific circumstances inter-group exchange can be an important force for social change.

An incipient hierarchy can be stimulated into developing fully through its control over exchange. A small party of men travelling to conduct exchange with a distant group will automatically gain control over exchange and its products. If marriages are arranged at the same time they also gain reproductive control. One of their number may become the group leader, and some level of hierarchy may develop (Marquardt 1985). Control of trade by a small number of individuals acting on behalf of a group can lead to the development of "Big Men". Trade networks allow Big Men to draw on a very large resource base when building up wealth for themselves, or their group. The leaders are likely to try and enhance their position by stressing the differences within and between groups, and institutionalising social relationships (Lederman 1990). With exchange as the basis for power they may encourage the production of surplus for exchange, stimulating intensification, and increased productivity. The greater productivity of agriculture would be appealing to leaders aiming to increase their wealth and power.

Trade or exchange can stimulate sedentism. If trade is important to a group, a residential base may develop at the entrance to that group's territory, so they can control trade. This results in settlement hierarchy, and authority concentrated at the gateway

settlement (Hayden *et al* 1985). Gift exchange is more likely than trade or barter in ancient hunter-gatherer or early farming groups. Despite the social complexity of the Tlingit there was no trade or barter before European contact. The destruction of potlatch gifts, and the need to pay gifts back with interest, encouraged increased production (Oberg 1973).

Hodder (1977) suggests that social conformity may function to produce identifiable cultures, which are best identified at their boundaries. Changes in the degree of social unity may alter the degree and direction of mixing of material cultures. In the groups Hodder studied social conformity was sufficient to maintain a difference between groups, despite considerable trading and daily contact. For acculturation to take place it must be assumed that cultural conformity has considerably lessened, allowing the absorption of traits from another culture. Perhaps one mechanism allowing this would be if the two previously independent groups became allied, and saw themselves as parts of a larger group. Hodder also noticed single direction movement of cultural traits, into the least conforming society. Perhaps across the Mesolithic/Neolithic frontier in Europe groups already neolithized conformed strongly, but the Mesolithic groups were open to external ideas.

The rapid spread of European items across Ghana in the sixteenth century provides an example of extreme change in material culture, independent of demic diffusion, and language and social changes. Not only were foreign items imported, but local items imitated imported forms. The spread of the new culture was carried out along existing trade routes, crossing political and language boundaries, though the Europeans were physically represented only by a handful of Portuguese in Accra, who were soon expelled (Ozanne 1963). Mesolithic Britain had no market economy, but exchange networks must have existed, and the spread of new ideas could have been rapid, if these were appropriate to the existing culture or encouraged further development of social complexity.

2.2.5.3 Conclusion

This chapter has presented a variety of views on social and cultural change from the anthropological literature. The study of recent groups allows an understanding of the complexity of any transition, and the difficulty in identifying primary causes. Causal relationships rarely seem to be straight forward, especially where change happens largely through feed-back mechanisms.

The importance of the social sphere in determining how groups respond to changes in their environment is clear. To some extent cultural factors would seem to be more important than the physical environment in initiating cultural change. In this case the nature of its existing culture is important in determining how a group will react to new stimuli. If population movements are used to explain the spread of agriculture perceptions of fertility and yield, risk and more spiritual beliefs must have played a significant part in causing movement. Even if active adoption of agriculture by hunter-gatherers in Mesolithic north-west Europe is argued this does not appear to have been inevitable, suggesting that if groups did adopt they probably already possessed traits which made agriculture attractive to them. Social complexity is, at present, largely seen as the key to the adoption of agriculture. Socially complex hunter-gatherer societies would seem to possess pre-requisites that would make the adoption of agriculture easier and desirable. However, many of the conditions that are pre-requisites or causes of social complexity must have existed for a considerable time before the complexity actually developed. Sedentism and storage exist in past and present groups without causing significant social complexity, and hunter-gatherer groups are sufficiently flexible to adapt to most environmental changes with minimal social changes. Occupational differentiation may be a form of intensification, allowing more efficient exploitation of resources, but that does not explain why that intensification occurred. It could be possible that possession of the pre-requisites of social complexity, rather than the complexity itself, would be enough to make the late Mesolithic cultures amenable to agriculture, and the Neolithic culture.

Many aspects of social complexity are potentially archaeologically visible, and it is possible that the degree of complexity of British Mesolithic groups could be reflected in the archaeological record. If a change from simple to complex social organisation can be demonstrated it could indicate that the adoption of agriculture was a continuation of a long-term process. A lack of evidence for social complexity in the late Mesolithic may suggest agriculture was imposed from outside; Mesolithic groups perhaps being absorbed into an essentially alien, but attractive culture. Alternatively, the exposure of Mesolithic groups to Neolithic culture could have initiated the rapid development of social complexity, that had previously been latent. The application of models based on ideas of social complexity developed by anthropologists may allow the modification of existing archaeological theory, and a more complete interpretation of the data. Unfortunately to test these theories concepts of some complexity must be identified in the archaeological record, and in most case this record would seem to be a poor tool for this purpose.

The relative importance of economic and social motivation for the appearance of agriculture in Britain can only really be determined if the relationship between agriculture itself and the cultural aspects of the Neolithic can be established. In the following chapters dating and palynological evidence will be investigated in an attempt to elucidate this relationship.

**CHAPTER 3: CATALOGUE AND ANALYSIS OF RADIOCARBON DATES
RELEVANT TO THE BEGINNINGS OF FARMING IN GREAT BRITAIN AND
IRELAND.**

3.1 Introduction

Theoretical ideas of social and economic change possibly relevant to the beginnings of agriculture in Great Britain^{have} been discussed above. To assess how closely these fit the existing evidence from Britain this evidence must be first be analysed to ensure that common interpretations of it are correct. The aim of this chapter is to place the transition from hunter-gathering to farming in Britain in a chronological context. Many authors quote dates for the start of the Neolithic (e.g. Darvill 1987, Savory 1980), yet few adequately support their assumptions. Smith (1974) presented a small number of dates in her summary of the Neolithic, and recently Williams (1989) made a more extensive attempt, using late Mesolithic as well as Neolithic dates. Darvill (1987) provides a particularly good example of the manipulation of radiocarbon dates in a wholly unsubstantiated way. The use of dates in synthetic works in general so lacks in rigour that no interpretation based on dates can be accepted without checking the original site report.

Radiocarbon dating has played an important part in the study of the Neolithic from its first application in archaeology. It has lengthened the duration of the Neolithic by at least a millennium compared to that proposed by Piggott (1954). At present it is one of the few methods available for the study of the temporal relationship between Mesolithic and Neolithic sites. The use of the term "absolute dating" in reference to scientific techniques such as radiocarbon dating is confusing. These techniques are independent of archaeological reasoning, but they involve inherent errors, and the results are as vulnerable to manipulation and subjective interpretation as any archaeological data. A brief discussion of the major problems of radiocarbon dating therefore seems appropriate before analysing the existing data.

3.2 Radiocarbon dating

In some respects this study is a little premature because, despite its 40 year history, radiocarbon dating is only just coming of age. Dating laboratories are beginning to standardise their methods and establish procedures for checking the reliability of dating apparatus, both internally and in comparison with other laboratories. If the Quality Assurance programme devised by the International Collaborative Study (Scott *et al* 1990) is widely applied future dates will be more reliable, and easier to interpret and compare.

While the date producers are taking major steps towards reliability and self regulation, date users seem a little further behind. Some projects make a real effort to select the most useful material for dating, and thoroughly consider all the factors that can alter or bias a date. One of the most notable of these is the Somerset Levels project whose dating policies are stated by Orme (1982). Perhaps most important of these is the realisation that several dates are needed to date securely a phase or feature. Other potential sampling errors are becoming more generally considered, with most excavators making an effort to avoid heart wood, contaminated samples and insecure contexts. However, many of the older dates are on poorly identified materials with have been bulk sampled, and can, at best, only give a generalised date for activity on a site.

Carbon exists naturally as three isotopes, ^{12}C , ^{13}C and ^{14}C ; only the last is radioactive. 99% of carbon atoms are ^{12}C , with about 1% ^{13}C , and a tiny fraction, $10^{-10}\%$, of ^{14}C (Taylor 1987). The small proportion of natural ^{14}C is the cause of many of the problems associated with its measurement. ^{14}C is produced naturally in the upper atmosphere by the bombardment of air atoms by cosmic radiation. The ^{14}C created in this way then decays to non-radioactive ^{14}N at a constant rate (Mook and Streurman 1983).

Though ^{14}C production is not uniform throughout the upper atmosphere, atmospheric turbulence causes such efficient mixing that the ^{14}C concentration in the lower atmosphere is virtually uniform world-wide (Taylor 1987). The world-wide uniformity of ^{14}C concentration is central to the theory of radiocarbon dating, which assumes uniform ^{14}C activity in all contemporary organisms. Until recently this had not been adequately tested, and some doubts had been cast on the international applicability of calibration curves (Collis 1971). A study by Stuiver and Pearson (1986) now provides strong evidence that the assumption is reliable. They found that wood of the same age from Ireland, Germany and the United States differed on average by only a few ^{14}C years, a difference so small that the same results could have been produced from a single tree. Dates on wood samples from the southern hemisphere appear consistently about 30 years

older than ones from the northern hemisphere, but ^{14}C activity seems to be uniform throughout each hemisphere.

It can therefore be assumed that, before recent industrial and military carbon emissions, the concentration of ^{14}C in the atmosphere was uniform throughout at least the northern hemisphere at any one time. As terrestrial organisms take up ^{14}C , either directly from the atmosphere, or by ingesting it in food, these achieve equilibrium with the environment. The ^{14}C concentration in all terrestrial organisms alive at any time should therefore be uniform. When an organism dies it is cut off from the carbon cycle, and can no longer maintain equilibrium with its environment. The ^{14}C in the organism decays to ^{14}N without being replenished. Radiocarbon dating measures the residual ^{14}C activity in the organism, and from this calculates how long ago it died.

Of course, in reality the situation is not so simple. Many organisms do not take all their carbon directly from the atmosphere; this especially applies to aquatic organisms. For small bodies of water the exchange with the atmosphere is rapid enough for the ^{14}C activity to be the same, but in larger bodies, such as oceans, the difference in ^{14}C concentration between the water and the atmosphere can be significant. The surface layer of the oceans may be near equilibrium, but the boundary between this and the deep layer is fairly well defined and offers resistance to the exchange of CO_2 . The level of ^{14}C is lower in the deep water, as it is retained in this layer long enough for significant decay to occur (Olsson 1983). The oceans are, therefore, a carbon reservoir with an older apparent age than the atmospheric reservoir. Any organism using marine carbon will also have an older apparent age than contemporary terrestrial organisms. The reservoir age of coastal waters varies due to upwelling currents, and the degree of mixing between surface and deep water layers. On the coast round Britain the reservoir age is about 400 years, northern waters appearing slightly older than southern (Harkness 1983).

Carboniferous rocks also form a major carbon reservoir, but exchange between this and the atmosphere is very slow, and the ^{14}C has completely decayed. Fresh water containing dissolved carbonates from this reservoir will appear excessively old. There is no way to calculate and correct for this hard water effect, and materials suffering from it are unsuitable for dating (Evin 1983). Even in regions without carboniferous rocks, the ground water may be deficient in ^{14}C if it travelled underground, cut off from the atmosphere, and ^{14}C decay has occurred without replenishment (Olsson 1983). Organisms obtaining much of their carbon from ground water, e.g. terrestrial molluscs and freshwater aquatic plants, can be highly unreliable dating material.

3.2.1 The nature of a radiocarbon date

A radiocarbon date is not a date in the usual calendrical sense, but rather a span of time (Pearson 1987). This span varies in length in relation to the reproducibility of each measurement, and is based on the distribution of determinations of ^{14}C activity round a median value. This median is merely the centre of the time span in which the true date probably falls, and not the true date itself (Harkness 1983). The presentation of a date with standard deviations round the mean causes some confusion, as it implies the measurements form a standard Gaussian (bell-shaped) curve (JH Ottaway 1983). If many dates are done on one sample, and presented in a histogram they do approximate to a Gaussian curve round the true date (Harkness 1983), but one date alone does not relate to the true date in any simple way. Radioactive decay is a random process, and no two measurements made on the same sample under the same conditions are likely to give the same result. In theory the true level of activity could only be obtained after counting for an infinite length of time (Mook and Streurman 1983). The true date could probably be accurately estimated from the mean of about 100 measurements. As this is not practical the date normally produced is just one of these 100 measurements (McKerrell 1971). The measured date's median is therefore not directly related to the true date, and is no more likely to be the true date than any other point within the quoted error of the measured date (Harkness 1983).

3.2.1.1 Standard errors

The standard error quoted with a central date gives some indication of the probable range in which the true date will fall. This is based on the square root of the number of radioactive decay events counted, and at least 10,000 counts are necessary to ensure a reasonable degree of accuracy (McKerrell 1971). Standard errors normally quoted include the statistical error on the counts of background radiation, the modern standard, and the sample. However, some laboratories try to estimate the full range of laboratory errors that influence the reproducibility of the date. This will continue to make comparisons of the dates difficult until a standard convention is established.

Errors from counting statistics alone do not give an accurate estimate of the reproducibility of the date. Other errors influencing the reproducibility of a date are introduced during the preparation and measuring of the sample. Most of these errors can be minimised with adequate facilities and care at all stages of the procedure (Pearson *et al* 1986). This has been achieved by the high precision laboratories, but not all laboratories have the facilities capable of this level of accuracy (Stenhouse and Baxter 1983).



It is a convention to quote the error to one standard deviation, giving a date range with only a 68% probability of including the actual date. Therefore two standard deviations (95% probability) should be used when comparing dates. All the graphs in this thesis show two standard deviations. This makes conclusions drawn from the dates very generalised, but emphasises the real limitations of radiocarbon dating, which can only give general chronological indications.

The choice of low standard errors selects for the more accurate dates, and makes comparisons between dates clearer. Williams' (1989) criterion was a maximum error of ± 160 years, and Kinnes (1985) chose ± 150 . There seems to be little consensus as to what constitutes an excessively large error, and certainly errors greater than about ± 150 years do result in very unwieldy dates, especially at two standard deviations. In selecting my dates I have been rather arbitrary and inconsistent in my definition of an excessive error. For environmental and Neolithic dates I have basically followed Williams and Kinnes. I have retained some determinations associated with Mesolithic material despite their larger errors, as there are comparatively few fourth millennium bc Mesolithic dates, and it is hoped that comparisons with more precise determinations will suggest in which part of the date band the true date probably falls.

3.2.2 Dating Laboratories

3.2.2.1 Interlaboratory comparability

The variety of factors which can introduce errors into isotopic determinations mean that not all dating laboratories can be assumed to produce comparable results. McKerrell's (1971) comparison of the British Museum and the University of California laboratories gave a statistically significant agreement of results, but subsequent tests were less encouraging. Two large scale interlaboratory comparisons have been carried out, both with very similar results, indicating little improvement since the results of the first of these were published in 1982.

20 laboratories participated in the International Study Group (ISG) (1982) and 52 in the International Collaborative Study (ICS); 37 completing all stages (Scott *et al* 1990). While quoted errors adequately described the reproducibility of a date within most individual laboratories, systematic errors caused greater variations between the laboratories. The ICS indicated that this bias fluctuated over time as procedures were improved or problems occurred. Only 15 of the laboratories completing the three stages

had no significant systematic bias. The value of interlaboratory comparisons is emphasised by the example of the British Museum Laboratory. The participation of the BM in the ISG revealed that their dates were consistently 200 years younger than the consensus. Subsequent checks identified the sources of error and enabled the dates to be corrected, and the whole facility upgraded (Bowman *et al* 1990).

In the near future the Quality Assurance Programme described by Scott *et al* (1990) should ensure much better comparability between laboratories, but at present there is little that can be done to avoid this problem. The ISG produced generalised multipliers, which when applied to quoted errors reflect the actual interlaboratory variation more accurately. Different multipliers were suggested for the various dating methods, as liquid scintillation counters appeared to be less accurate than proportional gas counters. This may be true overall, but it overlooks the carefully run scintillation counter, or the gas counter experiencing problems, for which the generalised multipliers may not be appropriate. Errors are so individual to each laboratory that general multipliers can never be accurate, especially as the multiplier for any one laboratory changes over time. Some laboratories have tested the difference between their quoted errors, and the actual reproducibility of the date, and have produced their own error multipliers (Stenhouse and Baxter 1983). Again changes over time mean that an error multiplier published some years ago may not be applicable to the most recent dates produced by the laboratory.

More importantly only 20 of the 100 laboratories in operation were willing to be involved in the ISG trial, so it is difficult to be sure whether the results are representative of all laboratories. Due to these doubts about error multipliers I have not applied multipliers to the dates catalogued in appendix II. The application of multipliers up to 3 (ISG 1982), combined with the use of dates at two standard deviations would effectively remove all visible patterning from the data. The use of two standard deviations, and an awareness that anomalous dates could result from problems of interlaboratory comparison seems a more workable approach. Figure 3.1 showing early Neolithic dates from appendix II sorted by laboratory, reveals that no single laboratory consistently produces anomalous dates. However, this does not adequately identify dates which are too early for their context, though generally within the early Neolithic range. To achieve this detailed and critical analysis of dates for particular pottery and monument types would be needed, which is beyond the scope of the present study.

The problems of interlaboratory comparison mean that it is generally safer to date all samples from one site at the same laboratory, and preferably within a short period of time to reduce the laboratory variation and make intrasite comparison of dates fairly

reliable. However, some samples may need to be dated using AMS, or other reasons can demand the use of more than one laboratory. Some sites included in appendix II have dates on single features which have been carried out at more than one laboratory¹⁰. In these cases the dates are closely comparable, and suggest that interlaboratory comparability can be possible. McKerrell (1971) recommends that archaeologists, when obtaining radiocarbon dates, should inquire about sample pretreatment, techniques used, and statistical error. These factors clearly could not be checked for this study, so that reliability and comparability of the laboratories had to be assumed.

3.2.3 Dating materials

Williams' article in *Antiquity* (1989) essentially formed the starting point for my own study. Her date list was composed only of dates on charcoal to avoid problems of comparability between different dating materials. However, this seems unnecessarily restricting, and some degree of comparability should be possible. While in theory any material containing radiocarbon can be dated some are more suitable than others. Every material has different problems and benefits associated with its use for radiocarbon dating. Rather than concentrating on a single sample type it seems more productive to attempt the comparison of different materials, assuming these have been appropriately treated. In this chapter the available dates will be analysed, and problems associated with specific dates will be discussed either in the text or in appendix II.

3.2.3.1 Charcoal

The vast majority of dates have been carried out on charcoal, and only recently have other materials been commonly used. Amongst the dates collected for this study charcoal is used for more dates than the other materials combined. Yet it is not necessarily the most reliable material. Initially charcoal provided more reliable dates as it does not require the extraction of a chemical fraction to remove the possibility of contamination. Its pretreatment, involving washing in acid and alkali to remove carbonate and humic acid contaminants, is standardised in most laboratories (Taylor 1987). However, in the past charcoal was often collected as bulk samples, the provenance of particular pieces could not be known, and dates could be little more than an average for various activities, possibly spread over a considerable timespan.

¹⁰ i.e. Peacock's Farm (appendix II, N/TL4), Giant's Hill 2 long barrow (N/TF2), Sweet track (N/ST5).

It must be remembered that the death of the living material is dated not its incorporation into an archaeological layer. The heartwood of a tree is cut off from the carbon cycle many years before the tree itself dies (Simonsen 1983). Dendrochronological studies have shown that oak trees as old as 400 years were used in Neolithic constructions (Hillam *et al* 1990, Morgan 1990). A date on the heartwood of one of these trees would be significantly earlier than the tree's death, the event which it is the intention to date. The solution to this problem is to date only small branches and twigs, which are demonstrably young pieces of wood. This is often not possible, but charcoal may also be identified to species. While oak charcoal may be from long lived trees, short lived species, such as hazel and birch, are unlikely to be more than a few decades old (Simonsen 1983). Also birch decays quickly even in a cold climate, so it is very unlikely to be reused as oak timbers often are (Nydal 1983).

This does not necessarily mean that dates on old timbers should be rejected as Williams (1989) does. The context of many of the old timbers is very secure if they form part of a structure, as at Ballynagilly, County Tyrone (ApSimon 1976), so large timbers do have some advantages over small, easily transportable fragments. The age of the original tree may possibly be estimated if the size and species of the timber is known. Timber dates may also occasionally be checked against dates on short-lived materials, e.g. at Balbridie, Grampian, dates on cereal grain suggested that the old wood effect on charcoal dates was no greater than the standard error on the dates (Ralston 1982).

3.2.3.2 Wood

Wood is pretreated in the same way as charcoal, but as well as contaminants the more mobile fractions of the original wood are removed, e.g. resins and sugars, as these can move radially in the wood and confuse more precise dating. This leaves a fraction consisting of stable compounds; lignin and cellulose. When tree rings are used in calibration studies the sample is more rigourously treated, and almost pure cellulose is extracted (Mook and Streurman 1983).

Wood is generally easier to identify to species than charcoal, and in some cases sapwood may be identified so isotopic dates on large timbers do not necessarily suffer from the old wood effect. Perhaps the most significant factor about wood as a dating material is that, if it is well preserved, it can also be independently dated by dendrochronology. This involves the matching of ring widths in the sample to a master series made up from a large number of trees. The technique does not suffer from errors in the way that radiocarbon dating does, and can, in theory, produce the exact year that the

tree was felled. Considerable work of this nature has been carried out in the Somerset Levels on the Sweet Track, and its construction has been dated to a single year (Hillam *et al* 1990). Few sites are suitable for dendrochronological dating, but enough waterlogged sites exist for this to, potentially, provide a secure framework against which to compare radiocarbon dates.

3.2.3.3 Bone and antler

Some problems have been encountered dating these materials because of their unstable nature (Gillespie *et al* 1986). In the early days of radiocarbon dating the whole bone was used, but these dates were often unreliable. This was due to post-depositional precipitation of carbonates, which cannot be separated from the original inorganic constituents of the bone. As early as 1961 the British Museum laboratory was dating only the organic fraction of bone and antler (collagen) (Barker and MacKey 1961), and all dates on bone or antler in appendix II are on this fraction, unless specified otherwise.

The standard procedure for the extraction of collagen cannot remove all contaminants, but despite this bone and antler are now considered the best materials for dating. According to Evin (1983) 80% of dates on bone produced by the laboratory in Lyon, France, between 1976 and 1981 agreed with expected results, compared to only 60% for wood and charcoal. Bone and antler have several advantages over charcoal as a dating material, though they do not preserve as well as charcoal, and so are found on fewer sites. The provenance of bone is generally more secure than that of charcoal, because the fragments are often larger, and less mobile in the soil. Its relationship to archaeological events is often closer. The very presence of concentrations of bone on a site may be indicative of human activity, and some samples are very closely associated with certain activities, e.g. butchering marks or the presence of domestic species. Many artefacts are made of bone or antler allowing the direct dating of a cultural indicator. Human burials may also be directly dated. Dates on bone can, therefore, often date archaeological events directly, whereas the relationship of charcoal to specific activities is harder to demonstrate.

The ability to date artefacts and burials directly has been improved by the development of counting methods, which require less sample material than conventional counters. Complete artefacts no longer need to be sacrificed to obtain a reliable date as

Accelerator Mass Spectrometry (AMS)¹¹ requires only 1-5g of bone compared with 100-500g for conventional methods (Gillespie *et al* 1984). In addition to the AMS counter at Oxford, Harwell has developed a small gas counter, which requires rather larger samples, but is still an improvement on conventional counters, without significantly increasing the errors (Otlet and Evans 1983).

The advent of AMS dating has enabled specific chemical constituents of well defined purity to be dated. This removes the risk of contamination. Collagen can be contaminated by humic compounds in the soil, and the extraction of amino acids of which collagen is composed removes most of these contaminants. An even purer sample can be achieved if hydroxyproline is extracted. This is a single amino acid, which is exclusive to collagen, and provides the most reliable fraction for dating (Gillespie *et al* 1984).

Dating bone and antler becomes problematic when preservation is poor. In aerated acid conditions with good drainage, such as river gravels, collagen may be leached out of the bone, and too little may remain to allow a reliable ¹⁴C determination. However, antler has more collagen than bone, and may be more reliable over a wider range of conditions (Gillespie *et al* 1984). Burnt bone also has very little collagen. In these cases dating of the inorganic carbon may be attempted, but the results should be considered with caution.

3.2.3.4 Shell

Of all the most commonly dated materials shell is perhaps the most problematic. Terrestrial mollusc shells are almost impossible to date reliably. Like all shells they are subject to post-depositional recrystallisation of carbonates in the structure of the shell, and other contamination from ground water. These can largely be removed by careful analysis of the shell structure under an electron microscope, and chemically removing contaminated layers (Yates 1986). However, there remains the problem of hard water error. Where there are carbonates in the ground water molluscs will use this as a source for

11. Accelerator mass spectrometry (AMS) can date samples as small as 100 micrograms of carbon (Batten *et al* 1986), by using a process in which ions prepared from the sample are accelerated in a vacuum, deflected off course by a magnetic field, caught, and measured. Heavier ions are harder to deflect because of their greater inertia, which enables ions of different mass to be separated (Taylor 1987). AMS dating is subject to errors and background radiation in the same way as conventional methods. The reproducibility of dates by the AMS method is now comparable to the conventional methods, and the average error quoted by Oxford AMS laboratory is ± 80 years. While it should be possible to improve this, AMS is unlikely ever to equal the accuracy of the high precision conventional laboratories. However, the ability to date precisely defined samples enables the archaeological error to be significantly reduced (Hedges 1986).

constructing their shells. This carbonate will often originate from the underlying rocks, and will have minimal ^{14}C . The shells will, therefore, appear anomalously old. Factors affecting dissolved inorganic carbon in fresh waters are too complex to allow a correction to be calculated for this (Evin 1983).

Marine mollusc shells are more amenable to dating, though there are still considerable problems with contamination. Once buried, the shells are subject to chemical changes, the most important being the recrystallisation of carbonates in the shell matrix. These recrystallised compounds contain contaminating carbon, and will produce anomalous dates if sampled. Etching the surface of the shell with acid will remove most of the contamination, and x-ray defraction will reveal recrystallised areas. Further acid treatment results in two or more fractions, usually the inner and outer fraction of shell material. If both these are dated, and the dates are similar, then contamination due to recrystallisation has been successfully removed. If disparate dates are produced, the samples are contaminated and should be rejected. However, the inner fraction will suffer less from recrystallisation than the outer fraction, and this is often acceptable (Sutherland 1986).

The problems of reservoir effects have been discussed above, but marine shells also suffer from isotopic fractionation¹², and corrections should routinely be made for these. In practice this is sometimes difficult as laboratories are not consistent in the methods used to calculate the dates. Some laboratories normalise the date in relation to 0‰, rather than -25‰, as is the convention for other materials. This corrects for the isotopic fractionation, and cancels out the marine reservoir effect in British samples. Many laboratories routinely normalised the dates in relation to -25‰, and a correction for reservoir effects is necessary. This is the most accurate and preferred method, but clear explanation of which method is used is not always published with the dates (Harkness 1983). Shells from estuaries fed by hard water rivers should be treated cautiously as they may suffer from hard water error as well as the normal marine reservoir effect (Sutherland 1986).

The shell dates which appear in appendix II have been corrected using the reservoir correction factor calculated by Harkness (1983), 405 ± 40 years, where this is necessary. Most laboratories which correct routinely for isotopic fractionation have published this fact in the journal Radiocarbon. Where no such statement exists I have assumed that the laboratory does not do this, and as a result no reservoir correction is

12. See appendix I, note 3.1 for a discussion of isotopic fractionation.

needed on these dates. The raw dates are listed in the "Context and Comments" section of appendix II.

3.2.3.5 Peat

Peat is problematic for dating as its contaminants are often difficult to identify. Several compounds are formed within peat, the most stable of which are fulvic acids, humic acids and humin. Fulvic acid is soluble in acids, and humic acid in alkalis, so these are mobile in the ground water in different conditions, and can be precipitated if the pH value changes (Mook and Streurman 1983). While in solution they can percolate down through the deposit, or be carried upwards by capillary action or a rising water table. Fulvic acid is generally composed of later contaminants, and is usually removed in pretreatment, though it only forms a small proportion of the peat, and probably has little effect on the final result. Humic acid forms about 60% of peat, and therefore is an important component of dating samples (Harkness pers. com.)

Though the humin fraction, composed of vegetable matter, is immobile, roots from later plants may penetrate lower layers. Root contamination can not always be distinguished in the laboratory, though recent roots may be noticed in the field while they are still fresh. While humic acids may move up and down in a deposit, humin is only likely to be contaminated by younger material, though it is impossible to make a correction for this effect, and there is little assurance that the humin fraction is any more reliable than the humic fraction (Mook and Streurman 1983). This problem is illustrated by the dates from Williamson's Moss (Bonsall *et al* 1989). Samples for the pollen core had dates on both humic and humin fractions, and the former were consistently, significantly older than the latter. There was no indication that the humin dates should be accepted, despite the humic date for the elm decline (traditionally dated about 5000 BP) being rather early. In addition to the peat dates, there are also dates on brushwood from timber structures, which are stratigraphically related to the peat core. The sample taken at 337cm to date the elm decline was at the same stratigraphic level as the dated brushwood, and the humic date for this sample corresponds very closely with these dates.

Tipping (in Bonsall *et al* 1989) published the mean of the humic and humin fractions because of the uncertainty of the carbon origin in both, but it is possible that in this case the humic fraction is more reliable (Tipping pers. com.). Schoute *et al* (1983) also found the humic fraction was more consistent, and related better to the existing chronological framework in their work on marine transgressions in the Netherlands. More detailed work by Shore (1988) suggests a complex relationship between the humin and

humic components of peat, and there is no easy rule as to which is the more reliable for dating. In general dates are done on whole, acid washed peat, i.e. after fulvic acid has been removed, but before any other fractionation. This provides an average of the humic and humin dates, but where these are dated separately a weighted average relating to their contribution to the carbon of a sample can be calculated.

3.2.3.6 Lake sediments

These are possibly more problematic than peat, as the origin of the carbon in a sample is even more uncertain. However, they are widely used for dating pollen diagrams. The organic component of lake mud can originate from plants and animals living in and around the lake, or from material washed in from the catchment area. The latter can be recent vegetation or reworked carbon, which has eroded out of the soil, and may be very old. Inorganic carbon from the ground water adds further confusion, as it is often depleted in ^{14}C . Large lakes may even retain ^{14}C for long enough to develop a reservoir age (Olsson 1983). Olsson (1986) has demonstrated that lake sediments can have a lower than atmospheric ^{14}C activity, and care should be exercised when comparing dates on lake mud to those on peat.

Once deposited on the lake floor the sediment is subject to mixing by lake fauna and water turbulence, though it is unaffected by root penetration unless the sample is taken from the lake margin. Water turbulence at the sediment surface is generally minimal in the deepest part of a lake, and core samples taken there will be less disturbed. Mackereth's (1965) studies of lake sediments demonstrated that most of the carbon was in-wash from the catchment area, and therefore, possibly old reworked material. The carbon content of the lakes studied varied in relation to the amount of erosion in the drainage basin, rather than the biological productivity of the lake. Organic material produced in the lake is rapidly oxidised, and only in-washed material is stable enough to become incorporated into the sediments. The presence of reworked material is especially noticeable for periods when soil erosion is severe, and older deposits are being eroded and introduced to the lake sediments. Samples from such deposits will often produce anomalously old dates, which will appear as reversals in sequences of dates¹³. These should be rejected as it is impossible to determine to what degree the dates have been contaminated.

13. E.g. date reversals found in the later levels of a core from Braeroddach Loch, Grampian (Edwards 1978).

The reliability of dates on lake sediments and peat cannot be quantified. While their precision is probably adequate for palynological studies, archaeology requires a tighter chronological framework, and it is uncertain how well these dates relate to those on archaeological contexts. Care clearly must be taken when comparing dates from these different sources.

3.2.3.7 Dating materials in the catalogue

If the dates from early Neolithic features from the catalogue in appendix II are plotted by dating material it can be seen that no single material has produced very early results (figure 3.2). Only 5 dates extend significantly before 3500 bc, and they are fairly evenly spread between the material types. All groups have a fairly similar range of dates, though animal and human bone dates seem to cover only the later part of the range. While the similarity of the range of dates cannot imply that the materials are directly comparable, at least it demonstrates that there are no gross differences in the reliability of various materials. The graph clearly demonstrates the frequency with which charcoal is used as a dating material, as dates on this material are more common than the other categories combined. The "other" group includes miscellaneous materials, such as hazelnut shells, cereal grains, and peat.

3.2.4 Calibration

The original theory behind radiocarbon dating assumed a constant rate of production of ^{14}C , before industrial times, but dating dendrochronological sequences demonstrated this to be untrue (Pearson 1987). Naturally produced ^{14}C in the atmosphere has decreased by almost 10% over the last 6000 years, which is generally attributed to an increase in the strength of the geomagnetic field (Bruns *et al* 1983, Libby 1971). Other smaller fluctuations in ^{14}C productivity of 100 years or less are probably connected with solar activity (Stuiver and Quay 1980). These short term fluctuations are most evident in short-lived material, e.g. cereal grains, as they are averaged out in dates on long lived species, especially timber. As the magnitude of these fluctuations can reach 3% (± 120 years) the error can be significant (Fletcher 1975).

The deviation of radiocarbon years from actual calendar years can be calculated by dating known-age materials. The most reliable method of achieving this is to use dendrochronologically dated tree rings. This provides a source of very accurately dated samples the ^{14}C activity of which can then be measured, and a correction curve produced

(Pearson 1987). Routine calibration has been resisted in the past by archaeologists (MacKie *et al* 1971), but the arguments against this are becoming less sustainable (Pearson 1987). The major objection has been the lack of a definitive curve. However, the publication of a high precision dendrochronology curve by Pearson *et al* (1986) has largely solved this problem up to 5210 cal.BC. The dendrochronology sequence was constructed mainly from Irish bog oak. It contains ring patterns of 1035 trees, with no less than 6 trees spanning any one year, and is "*totally internally consistent*" (Pearson *et al* 1986 p912).

High precision dating techniques enabled errors to be reduced to less than 20 years, including an error multiplier to take non-counting errors into consideration. The first 4500 years of the curve were compared to another high precision curve constructed by Stuiver and Becker (1986) from Californian bristlecone pine trees. These compared very closely, and no significant bias could be detected in either set of results. This is important not only as a check on the reliability of the two curves, but demonstrates that they are internationally applicable. The difference in species, altitude or geographical location could not be shown to have altered the ^{14}C activity in the timber. Therefore, the first part of the Pearson *et al* curve has been shown to be both accurate and applicable. There is no reason to suspect any faults in the latter part, though it must be considered provisional until it too can be independently checked (Pearson *et al* 1986).

With a reliable curve covering 5210 cal.BC onwards there is much less excuse for not calibrating dates within this period. For some periods where the curve has many wiggles¹⁴, calibration can cause a significant difference to the distribution of dates. The late Mesolithic/early Neolithic is not such a period as calibrations by Switsur and Mellars (1987), and Williams (1989) have shown. However, the routine adoption of calibration in one period, and not in others can only cause confusion when broader sweeps of prehistory are considered. On an even broader scale the construction of time-lines extending through to historical periods (e.g. Darvill 1987) will be distorted if dates are not calibrated. The Mesolithic will be a problem for some time in this respect, but the calibration curve should eventually be extended to cover this, and hopefully earlier periods (Bruns *et al* 1983, Becker *et al* 1991). Evidence from Swedish varves suggest radiocarbon and calendar dates converge again by 13,000 BP, with the maximum deviation at about 5200BC (Clarke *et al* 1989).

At 5000 BP there is a large difference between ^{14}C and calendar years, so calibration will considerably lengthen the whole duration of the Neolithic. This must be of

14. A wiggle is "the expression used for short-term variations in the radiocarbon calibration curve on a scale of 50-500 years" (Ottaway 1983 p99)

theoretical significance, and can only be revealed by calibrating all dates not just those known to be in periods of high fluctuation. Also, the availability of computer programs for calibrating dates makes the process quicker and easier. I believe that these points make calibration necessary for this period, though clearly it will be a long time before a complete calibrated chronology can replace the present, uncalibrated one. The two chronologies must be used in parallel to identify problem areas, reconsider theoretical approaches where necessary, and allow familiarisation with the new chronology. To enable this to work a clear system of terminology is necessary to minimise confusion.

3.2.5 Terminology

Most authors discussing the introduction of agriculture use terms such as "BC" or "bc", yet, generally, these do not refer to dates in the Christian calendar. What is usually implied is a date in radiocarbon years from which 1950 years have been subtracted, to make it roughly comparable to the Christian calendar. However, in the period under study the difference between this date and the actual calendar date can be as much as 800 years (Williams 1989). The difference between 1950 and the present is fairly insignificant in terms of the accuracy of radiocarbon dates over 5000 years. 50 years could be added to dates BP or cal.BC if such false precision were required.

Many authors are now beginning to use calibrated dates, and usually make it clear when they are doing so, however, the established chronology for prehistoric archaeology is based on uncalibrated dates. Gillespie and Gowlett (1986) state that it is *"logically faulty to convert the raw BP scale to uncalibrated years relative to the Christian epoch (ad/bc), and the practice should be discouraged now that adequate calibrations are becoming available"* (p161). While this may be sensible advice for the future they also accept that this terminology was developed as a *"stop-gap"* enabling archaeologists to deal with dates before a reliable calibration curve was available. As the uncalibrated chronology underlies our understanding of prehistory this *"stop-gap"*, however *"logically faulty"* is still necessary, and will remain so until enough calibrated dates have been analysed to allow the conversion of the complete time-scale. In recognition of this I have used "bc" to denote uncalibrated dates in radiocarbon years minus 1950.

In other cases I have followed the conventions agreed by the International Radiocarbon Conference in Trondheim 1985, i.e.

- 1) The use of "BP" for dates in uncalibrated radiocarbon years.
- 2) That "bp" is an unacceptable alternative to the above.
- 3) The use of "Cal.BP" for calibrated dates.
- 4) The use of "Cal.BC/AD" for calibrated dates converted to the Christian calendar.

Gillespie and Gowlett (1986) present a sensible argument for the general acceptance of this system. The major factors being that "BP" was widely used for radiocarbon years before the calibration problem was realised, and continues to be used by over half radiocarbon date users, e.g. earth scientists, largely unaffected by calibration. A change to the general use of "bp" would lead to confusion on a wider scale than archaeology alone. Also, the use of higher case in relation to lower case implies a certain definitive quality about the date. Until 1986 any calibrations were no more than provisional, and even now it is possible that details of the Pearson/Stuiver curve may be improved on. The only really definitive date is therefore the uncalibrated date in radiocarbon years, and the use of "BP" stresses this.

Gillespie and Gowlett go on to highlight a further complication in that if "BP" is defined as radiocarbon years before present it cannot be used for other dating techniques e.g. dendrochronology and thermoluminescence. For these "ABP" (absolute BP) is suggested, though this usage has not been widely discussed. "ABP" would therefore be equivalent to "Cal.BP" for techniques where calibration is not necessary.

Together these conventions form a comprehensive system which retains the traditional usage of most terms, while making them applicable to as many disciplines as possible. In this respect it is preferable to some of the other systems proposed e.g. Mackie (1971), which have received little general acceptance. I will use the above system of conventions in the form stated, throughout my thesis.

3.3 Archaeological Dates

3.3.1 Introduction

Dates were initially collected from Radiocarbon, Archaeometry, and the CBA's Archaeological Site Index to Radiocarbon Dates for Great Britain and Ireland (CBA ¹⁴C Index), with a considerable contribution from a list of Neolithic dates compiled by Dr Ian Kinnes of the British Museum. The data collection was initially unselective, enabling all relevant dates to be collected, and only sorted on the basis of full site reports, not the very brief notes in the date lists.

Some of the dates in appendix II were obtained about thirty years ago, when counters were less accurate, and pre-treatment less rigorous. Kinnes *et al* (1982) have clearly stated that dates produced in the early stages of radiocarbon dating should be abandoned, because of their experimental nature and poor reliability. This is a very sensible suggestion, and I feel I must explain my reasons for ignoring it. The dates for the Transition demonstrate many disturbing features of the archaeological use of radiocarbon dating. Not only is there still a reliance on dates produced many years ago, but even some recent dates are far from satisfactory. In particular there is a large number of single dates, i.e. only one sample dated for a site often consisting of several phases. Orme (1982) recommends that at least three dates are necessary to date securely any phase or feature, as this allows the recognition of anomalous dates. The number of sites dated to this standard is extremely small, and the use of this as a selection criterion would result in the rejection of all but ten of the catalogued sites. In theory no other sites are sufficiently well dated, but to reject them all would do nothing to expand our understanding of the period.

The data for this period are, at present, so slight that nothing is gained by reducing them further as Williams (1989) does, by rejecting all the single dates. While "*it is clear that individual dates are suspect*" (Whittle 1988 p17) these form the bulk of the available data, and some attempt must be made to work with them. It seems sensible when studying a fairly unknown period to make use of all the available information, and attempt to take possible errors into consideration. Therefore, unlike Williams, my database includes dates on all types of material, from any laboratory, and also includes a more extensive study of dated environmental evidence. The aim of this approach is to cover as much of the country as possible, and to reduce the effects of artificial distribution patterns.

The dates were chosen using the following criteria:-

- 1) Sites referred to as Neolithic with a date band extending partially or wholly before 3000 bc (4950 BP) at one standard deviation.
- 2) Sites referred to as Mesolithic with a date band extending after 4000 bc (5950 BP) at one standard deviation.
- 3) Any site described as having both Mesolithic and Neolithic artefacts present in the same phase.

Out of necessity I have had to rely on the authors' cultural definitions. No sample type was rejected, though its nature and relationship to archaeological activity was recorded, and included in appendix II. While single dates were not rejected, these too were noted so that they could be compared to the more secure multiple dates. Dates were rejected if they had an excessive error, generally over ± 200 (except where the dates came from late Mesolithic sites, which were not rejected purely because of large errors). Other criteria for rejection were more subjective. Where there were several dates on a feature, a date that was inconsistent with the rest was rejected. Dates which were very poorly related to archaeological activity were rejected, as were those which other convincing evidence, such as a stratigraphical relationship with a well-dated feature, suggested were anomalous. Dates which are too early or late for inclusion in this study, but which are useful for comparison with accepted dates from the same site, are also included under rejected dates in appendix II.

Following Waterbolk (1971a) the dates were assessed to estimate the certainty of the dated material's relationship to the archaeological event to be dated, and the closeness of the date of the material to that of the event. These are recorded in appendix II as "certainty" and "closeness" respectively, and each date has a score for both (this scheme is fully explained at the start of appendix II). Dates scoring "A" in both categories are very closely related to the event being investigated, where as those scoring "D" are unreliable as dates for a specific archaeological event.

3.3.2 Calibration

All the accepted dates in appendix II have been calibrated for reasons discussed above, and graphs of both calibrated and uncalibrated dates have been included for comparison in the regional discussions. The computer programme produced by Washington University Quaternary Isotope Laboratory (1987) has been used throughout

for calibration. This uses the curves produced by Stuiver and Pearson (1986), a record of ^{14}C activity at 20 year intervals to 7210 cal.BC. No laboratory multipliers have been applied, and only the intercepts and age range were calculated (method A), rather than also calculating the probability distribution, which was considered unnecessary for such insecure dates.

Calibration has had a consistent effect on all the dates, indicating that the curve covering this period is unproblematic. There are certainly short term "wiggles" giving multiple intercepts on many dates, but these are generally too small to cause any significant alteration in the relation of the dates to each other. Calibration reveals that the raw dates are about 750 years too young. The effect of this is to extend the length of the Neolithic period, as the discrepancy will be smaller on dates for the end of the Neolithic. Short term fluctuations in the radiocarbon in the atmosphere can make two dates appear similar, when they actually date events that were relatively more separate in time. Calibration can reveal this problem, and place these artificially compressed dates in the correct relationship to each other. Calibration shows that this is not a problem during the period studied. Apart from extending the errors, in some cases not always symmetrically, calibrated and uncalibrated graphs are almost identical, discounting the gross temporal displacement. Because the difference is so slight I will discuss the individual dates using the more familiar terms "bc" and "BP" reserving "cal.BC" for the regional summaries.

Borland's Quattro Pro was used to produce the graphs, and the limitations of this programme dictated that only the lowest and highest intercepts could be shown. Full calibrated dates with all intercepts can be found in appendix II.

3.3.3 Analysis of dates by area

Figures 3.3 and 3.4 map the location of the dated archaeological sites discussed in the text and included in appendix II. Sites are listed in appendix II by the period attributed to associated artefacts (late Mesolithic, early Neolithic, and other), then grid square, then alphabetically by site name. The sites mentioned in the text are followed by a code which relates to appendix II. The site code is made up of a letter indicating the period (M=Mesolithic, N=Neolithic, O=other sites not attributable to one period), followed by the grid square code and site number. The numbers shown on figures 3.3 and 3.4 are site numbers, and also relate to the catalogue. Rejected sites discussed in the text are included in appendix II, and are sorted alphabetically by site name. The codes for these sites begin with "R", followed by the site number (they are not included on the maps). The catalogue

entry gives a bibliography for each site, the discussion in the text being based on these references.

The distribution of dated sites is uneven, and largely related to variable levels of research into the relevant periods. Grid square SU¹⁵ demonstrates the effect a concentration of research in one area has on the distribution pattern; dated early Neolithic sites in particular are concentrated in this square. Where dated sites are few, less confidence can be placed in them being representative of the area as a whole. In many regions, most excavation is dictated by rescue archaeology, and concentrated on the lowlands, especially along the coast. This may explain the lack of dated sites in the Scottish Highlands.

Unfortunately, dated sites for the late Mesolithic and early Neolithic rarely occur in the same areas making direct comparison difficult. When this does occur, e.g. in grid square SU, the Neolithic is usually fairly well dated, but the Mesolithic is represented only by a small number of sites, generally with single dates. A national analysis of the results may give a rough impression of the relationships between the two groups, but more detailed regional study is needed to reveal geographical trends. Williams (1989) claimed an overlap between Mesolithic and Neolithic dates on a basis of late dates for the former in Scotland and early ones for the latter in southern England. This clearly says little about the process of the Transition, unless a direct connection could be demonstrated between the areas.

For convenience in discussing the dates the country has been divided into arbitrary areas. These are defined by groups of dated sites within fairly close geographical proximity to each other, rather than the geographical similarity of certain areas. Though some of these areas are large, it allows a more detailed analysis of the geographical spread of dated sites, than discussing Britain as a whole. Factors influencing site location will be more thoroughly discussed in chapter 5, though they are briefly considered in this chapter where relevant.

While there are numerous dates from Neolithic contexts many of these are from monumental sites. 29 of the catalogued sites are described as funerary monuments, and another 19 are causewayed camps, henges and cursuses. It is arguable how well these relate to the beginnings of agriculture. Most authors assume that labour would not have been invested in monument building until the new subsistence economy was well established (e.g. Zvelebil and Rowley-Conwy 1984, Woodman 1992). Kinnes (1988), however, argues

15. See figure 3.4.

that early tombs are small-scale, and would not require great economic or social complexity to construct. Their ritual significance may have been as important to the food quest as any technological development, and they do not necessarily have to be seen as secondary components of the Neolithic. 35 occupation sites are listed in appendix II. These are non-monumental sites possessing features, such as pits and post-holes, as well as artefacts, suggesting their use for some unspecified, but presumably domestic, activity. These are, in general, no earlier than the monumental sites, though some tombs do have earlier occupation activity under them. Figure 3.5 demonstrates the similarity in the dates. There are a small number of particularly early dates in both groups, though the occupation sites do seem to have more of these. In this graph the sites have been sorted by grid square, so they are listed roughly from north to south. No area seems to have occupation sites dated consistently earlier than monumental sites, though it is difficult to draw conclusions at this general level. The graph presents no evidence for the reliability of the early dates, which may be poorly related to archaeological events, or suffer problems related to the dating material or techniques. The larger number of early dates from the occupation sites could be due to the dating of poorly provenanced charcoal, compared with better provenanced dates from the funerary monuments, perhaps on burials. In both cases the majority of the dates cover the period from 3250 bc onwards, but it is the minority of earlier dates that might be expected to indicate the first identifiably Neolithic sites. A more detailed study of the dates is clearly necessary to assess the reliability of these earliest dates.

There are surprisingly few Mesolithic dates extending after 4000 bc, compared to the quantity of Neolithic dates for the fourth millennium bc. Only 32 identifiably Mesolithic sites are included in appendix II, and little more than tentative suggestions can be gleaned from a database of this size. The dated sites are fairly evenly distributed across the country, suggesting that the scarcity of sites may be due to a lack of research. There are few areas where a secure date for the end of the Mesolithic can be claimed. Most dates are insecure, and the sample is so small that little confidence can be placed in it being representative.

I have summarised the Neolithic dates for each area by combining them to obtain a weighted average. This gives an estimate of the most probable date for the start of the Neolithic, as implied by the present radiocarbon evidence. The nature of the database means that many dates are questionable on their own, but combined with other statistically indistinguishable dates from the same cultural assemblage they may be considered with some measure of confidence. The weighted mean is not intended to be a precise and

accurate¹⁶ date in the sense used when combining several dates from the same feature. In this case it is intended purely as an estimate, emphasising the date suggested by the bulk of the determinations, rather than concentrating on odd, early, and possibly anomalous dates. In some areas, e.g. areas A, B, and C, I have included dates from all classes of sites, but in others, e.g. area G, where there are more dates, I have combined dates from each class separately, in an attempt to identify site-types that are consistently early, and ones that are generally later. It is unreasonable to use this method to date the end of the Mesolithic as the dates are so few and unreliable that the results would be meaningless.

3.3.3.1 Great Britain

Area A

(Figure 3.6)

This area covers much of the west coast of Scotland, and is the only area where the late Mesolithic is better dated than the early Neolithic. This situation is due to the considerable interest aroused by the Obanian culture of Oronsay, in the Inner Hebrides, and the area round Oban. This was once thought to be a local development of the ultimate Mesolithic, but recent dates have shown that it extends throughout the late Mesolithic, and possibly into the Neolithic, implying a stable, well adapted culture¹⁷ (Bonsall and Smith 1989, Connock *et al* in prep.).

Occupation on the Oronsay sites is firmly dated before 3500 bc. There is some indication of later activity, but all the determinations could represent a true date earlier than 3500 bc. A date of:-

5015±210 BP (3065 bc) GX-1903

came from Cnoc Sligeach (M/NR4), but it has been rejected from this catalogue because it was on a poorly stratified shell, and had a large error. Therefore about 6200-5400 BP (4250-3450bc) (Jardine 1987) represents a reliable date range for these middens.

16. "Accuracy denotes the nearness of a single measurement, to the exact or true value. Precision is a quality associated with a series of replicate measurements and refers to the way in which repeated measurements conform to themselves." From the mini glossary in Ottaway (1983).

17. Culture, in archaeological terms, can only mean the sum of associated artefacts, and often economic evidence, which is recognisably similar on various sites. It may be associated with huge exchange networks or with seasonal activities carried out by part of a family group. If the Obanian culture is associated only with seasonal activities, it still seems to remain constant while other activities change. The material culture associated with the specific activities would appear to be well adapted and, therefore, resists change.

Obanian assemblages are dated earlier than this on the mainland by two recent dates from sites near Oban (Bonsall and Smith 1989):-

7810±90 BP (5860 bc) OxA-1948 Druimvargie rock shelter

6700±80 BP (4750 bc) OxA-1949 MacArthur Cave

New dates suggest that it may also survive longer here. These dates are for a typical Obanian assemblage at Carding Mill Bay (M/NM1) near Oban, and suggest that this culture may survive at least until 3000 bc.

5060±50 BP (3110 bc) GU-2796

4980±50 BP (3030 bc) GU-2797

The two dates are very close¹⁸, and have small errors, but they are on bulk charcoal samples, which could include later charcoal. There is a beaker burial on the site, and some admixture had occurred, but it seems unlikely that the two dates would be so similar if they contained variable proportions of later material. Further dates from this site should clarify the situation.

The range of dates from the Oronsay sites are supported by two other determinations related to Obanian-type artefacts. A shell midden on Ulva, Mull (M/NM2) produced a date of:-

5690±60 BP (3740 bc) GU-2602

from a bulk sample of shells from the top of the midden, which contained occasional Obanian-type artefacts. The close agreement of dates on inner and outer fractions of the shells suggest there was minimal contamination, though the loose nature of shell middens makes the relationship between dated material and artefacts uncertain.

An Obanian-type antler point from the River Irvine at Shewalton, Strathclyde (M/NS2), was assumed by Lacaille (1954) to represent a Mesolithic group surviving into

18. Definitions of closeness of radiocarbon dates:

Very close = dates overlap at one standard deviation.

Fairly close = dates overlap at two standard deviations.

Significantly different = dates do not overlap at two standard deviations.

the Neolithic period. However, a date from this fits comfortably into the middle part of the date range for the Obanian:-

5840 \pm 80 BP (3890 bc) OxA-1947

There are very late radiocarbon dates from Jura, but these are not entirely satisfactory. Both of the Glenbatrick dates (M/NR5) have excessive errors, and would have been rejected initially, if there had not been so few Mesolithic dates. One date overlaps with the Oronsay sites at two standard deviations, and the true date is as likely to fall in this part of the range as around the mean date.

5045 \pm 215 BP (3095 bc) GX-2564

Also it is from an area which produced no artefacts, and as Neolithic artefacts were present on site the feature could belong to this phase of activity. The other much later date is more closely associated with Mesolithic artefacts, but considerable movement of artefacts in the soil was noticed so the relationship can only be tenuous.

4225 \pm 230 BP (2275 bc) GX-2563

This is also a single date with a huge error, and really should be rejected.

However, GX-2563 does overlap with two dates from Lussa River (M/NR6), also on Jura. These dates have reasonable errors, and relate to the last phase of Mesolithic occupation, phase 3.

4620 \pm 140 BP (2670 bc) M-556

4200 \pm 100 BP (2250 bc) BM-555

Despite Mercer's claim (Searight 1984) that this phase is contemporary with the Oronsay sites, the dates are clearly much later. The two dates do not support each other, only just overlapping at two standard deviations, and so must be considered as single dates on two different occupation events. The dates on the charcoal have no direct relationship to the lithic assemblage.

The only late dates with any credibility are, therefore, those from Carding Mill Bay, but this meagre hint means that the late survival of a recognisably Mesolithic culture in this area can not be rejected.

There are very few Neolithic dates for this region, and these all have central dates close to 3000 bc. The occupation under the Port Charlotte Clyde cairn (N/NR3), Islay, apparently lacked pottery, but fragments of sheep bones were discovered.

5020 \pm 90 BP (3070 bc) HAR-3487

4940 \pm 70 BP (2990 bc) HAR-3486

Hazelnut shells were also found, and the flint industry was not diagnostic, so an interpretation as a Mesolithic site, in contact with sheep herding communities is not impossible.

The site of Newton (N/NR2), also on Islay, produced a date of:-

4965 \pm 60 BP (3015 bc) GU-1952

from a pit containing early Neolithic pottery. This date was supported by a similar one from a stratigraphically related post-hole:-

4880 \pm 60 BP (2930 bc) GU-1951

The date from Monamore, Arran (N/NS1):-

5110 \pm 110 BP (3160 bc) Q-675

is possibly related to the use of this Clyde cairn. According to MacKie (1966) colluvium built up in the forecourt throughout the use of the tomb, and Q-675 came from an apparently undisturbed patch of dense charcoal within this deposit. The charcoal patch appeared to be stratigraphically later than the construction of the tomb, and presumably represents its use, assuming none of the charcoal had been washed in or introduced from a higher level. The presence of a glass bead in Neolithic layers demonstrates some migration of later materials into earlier horizons. A much later date:-

4190 \pm 110 BP (2240 bc) Q-676

from further up the same colluvial deposit suggests Q-675 may be anomalously early, or that the tomb was in use for a very long period of time.

The only other evidence for early Neolithic activity in the region are single dates on the Temple Wood henge (N/NR4), Kilmartin and Glenvoidean Clyde cairn (N/NR1), Bute.

5025±190 BP (3075 bc) GU-1296 Temple Wood

4860±115 BP (2910 bc) I-5974 Glenvoidean

From these dates it might be suggested that a recognisably Neolithic culture appeared in this area by 3120-2940 bc (3945-3693 cal.BC). This date has been produced using the weighted average of dates from: Port Charlotte, Monamore, Newton, Temple Wood and Glenvoidean. The pre-tomb deposit at Port Charlotte can be claimed as Neolithic only on the strength of the fragmentary sheep bones, but as these suggest the presence of livestock husbandry in the area, the date has been included. The dates from Carding Mill Bay correlate very closely to the estimate for the earliest Neolithic, and therefore may genuinely represent the end of the Mesolithic in the region. If the Lussa River dates are accepted it could suggest the continuation of typical Mesolithic lithic traditions along side Neolithic-type monument construction, though the poor contexts of these dates make them highly unsatisfactory as evidence for this theory.

Area B

(Figure 3.7)

Most of Scotland, excepting the west coast, has exceptionally poor dating evidence for both periods. In southern Scotland this evidence comes mainly from the south-west, and from the middens along the Forth estuary. A small group of sites from Northumberland has been included in this area, as they are geographically more closely related to the southern Scottish sites than any other group.

In south-west Scotland the only dated Neolithic site is Lochhill long cairn (N/NX1), New Abbey. This has a single date on one of the planks from the floor of the mortuary structure.

5070±105 BP (3120 bc) I-6409

While this date is closely related to the construction of the monument, it is likely to suffer from the old wood effect. However, the true date probably still falls within the rather wide range indicated by the radiocarbon date.

There is considerable Mesolithic activity in Dumfries and Galloway region, both along the coast and inland, but few sites have been dated. Some of the inland sites have been dated recently by Edwards (1989c p217). A late date was produced from Loch Doon (R16):-

3150±70 BP (1200 bc) OxA-1597

but the context is suspect for this, and the charcoal was probably of later origin than the occupation layer.

Another inland site, Smittons (M/NX2), produced one fourth millennium date, and an earlier date from different occupation phases.

6260±80 BP (4310 bc) OxA-1595

5470±80 BP (3520 bc) OxA-1594

These are on hazelnuts, which rules out any risk of old wood effect, and means that they are probably closely related to the occupation activity. There is no reason to doubt the later date, though again it is only a single date.

The other date from this region is a securely Mesolithic date on a hearth at Barsalloch (M/NX1). However, it was measured in 1969, and the pretreatment may not have been as thorough as is standard today.

6000±110 BP (4050 bc) GaK-1601 from Barsalloch

The early fourth millennium date on the antler point from Shewalton has been mentioned in reference to the Obanian above (p56).

There is, therefore, little evidence for either a late survival of Mesolithic traits, or an early presence of Neolithic ones in this area, though a real hiatus is unlikely. The Smittons date suggests a Mesolithic presence at least until 3500 bc, and this does overlap with the Lochhill date at two standard deviations, indicating perhaps the fairly late occurrence of Neolithic monuments in the area, and the presence of Mesolithic activity up to that date.

Fourth millennium bc dates come from Inveravon shell midden (O/NS1), on the Forth estuary. Activity on this site continues through to a late Neolithic/Bronze age date with the earliest dates probably representing Mesolithic activity.

6010 \pm 180 BP (4060 bc) GX-2331

5955 \pm 180 BP (4005 bc) GX-2334

The later dates possibly represent a continuation of activity on the site into the Neolithic period.

5030 \pm 72 BP (3080 bc) GX-1886

4705 \pm 72 BP (2755 bc) GU-1887

4245 \pm 140 BP (2295 bc) GX-2333

4200 \pm 120 BP (2250 bc) GX-2332

Late fourth millennium bc dates, associated with domestic animals and pottery, have been published for Nether Kinneil (R19), another midden close to Inveravon. However, these are all on marine shells, and were initially published without being corrected for the marine reservoir effect. If this correction is applied the dates are all too late to be included in this survey. The one date from Cadger's Brae midden (R5) also becomes too late to be included once it has been corrected. This emphasises the importance of applying the correction where it is known to be necessary. Both the dating laboratories involved - Scottish Universities Research and Reactor Centre, and the Glasgow University laboratories - correct for isotopic fractionation, requiring the user to correct for the reservoir effect (Harkness 1983).

Nether Kinneil

4835 \pm 72 BP (2885 bc) GU-1881 (uncorrected 3290 \pm 60 bc)

4655 \pm 64 BP (2705 bc) SRR-1486a (uncorrected 3110 \pm 50 bc)

4630 \pm 76 BP (2680 bc) GU-1260 (uncorrected 3085 \pm 65 bc)

4535 \pm 64 BP (2585 bc) SRR-1486b (uncorrected 2990 \pm 50 bc)

Cadger's Brae

4725±72 BP (2775 bc) GU-1884 (uncorrected 3180±60 bc)

The dates demonstrate the occurrence of shell collection in the Forth Estuary on both sides of the Transition, but there is a shortage of fourth millennium bc dates once the shell dates have been corrected. This could imply a hiatus in the activity between the early fourth millennium Mesolithic activity and the third millennium Neolithic activity. More sites need to be reliably dated to clarify this.

An antler mattock from Meiklewood (M/NS1), in the Carse of Stirling, is dated to the early fourth millennium, but this would seem to be too early to throw much light on the Transition in the area.

5920±80 BP (3970 bc) OxA-1159

Two dates from a post-hole on the Neolithic settlement at Thirlings (N/NT2), Wooler, and from the henge at Yeavinger (N/NT3) are roughly similar to the date on Lochhill cairn.

5230±150 BP (3280 bc) HAR-877 Thirlings

4890±90 BP (2940 bc) HAR-3063 Yeavinger

A recent excavation on Biggar Common (N/NT1), Peebles, has provided two additional dates, from an extensive burnt horizon (phase three) beneath a long cairn.

5250±50 BP (3300 bc) GU-2985

5150±70 BP (3200 bc) GU-2986

The excavator (Johnston in prep.) considers the charcoal layer to represent a single burning event, similar to those which appear to have occurred at Boghead and Pitnacree (see below p78, 80). The closeness of GU-2986 and GU-2985 suggests their reliability, though they could suffer from the old wood effect. Earlier activity on the site was represented by the post-holes of a structure, the average date for which was 6119±54 BP (4169 bc), though no artefacts were associated with the structure, and no microliths have been found during extensive fieldwalking on the Common.

A fourth millennium bc date from the Dunion (R9), Jedburgh, is clearly anomalous, as it comes from the post-hole of a house with a mean thermoluminescence

date of AD 180 ± 170 . The dated charcoal must have either been residual or ancient bog oak had been used in the construction.

The few early Neolithic dates from this area produce a combined date range of 3283-3127 bc (4035-3822 cal.BC). This range includes dates from Lochhill, Thirlings, Yeaverling, and the later dates from Biggar Common, but not the later dates from Inveravon, as these are not associated with Neolithic artefacts. The combined date is similar to that implied by Neolithic dates from the west coast, but in both cases the number of dates is small, and possibly not representative.

Area C

(Figure 3.8)

There is a scatter of dated early Neolithic sites further north. No late Mesolithic sites have been dated in this area, despite Obanian type material being found at Smoo Cave, and other late Mesolithic assemblages along the Caithness coast (Hunt 1987).

Balbridie (N/NO1), Deeside, is one of the most securely dated sites in the catalogue. 14 dates have been obtained on charcoal and carbonised seeds from the post-holes, and other structural features of the building. All seem to have been part of the structure when it was destroyed by fire. The closeness of so many dates suggests that the site is essentially single phased. Some old wood effect is to be expected, but this appears to be no greater than the errors on the dates, as the seed dates agree well with those on wood charcoal. It is justifiable therefore to combine the dates to produce a weighted average of 4975 ± 24 BP (3025 bc). Three dates which are a little later than the majority, and have fairly large errors have been excluded from the average (GU-1036, GU-1830, GU-1421). This demonstrates that arable agriculture was being practised and substantial buildings were being built in Scotland by the end of the fourth millennium bc.

The pre-cairn occupation at Boghead (N/NJ1), Fochabers, is also well dated. A layer of charcoal representing some sort of burning episode was dated by three dates (SRR-684, SRR-686, SRR-689) with a weighted average of 4873 ± 40 BP (2923 bc). Under this deposit hollows, stakeholes, patches of burnt sand and a central pit represented earlier occupation activity. The two dates from these were:-

5031 ± 100 BP (3081 bc) SRR-685

4946 ± 175 BP (2996 bc) SRR-683

Two other dates came from these contexts, but one (SRR-688) seems anomalously late, and the other (SRR-690) too early. SRR-683, from the central pit was associated with Lyles Hill-type pottery, implying the group producing these features possessed Neolithic-type material culture.

Evidence for Neolithic mortuary activity at this time comes from the enclosure at Inchtuthil (N/NO2), which has been interpreted as a mortuary enclosure from comparable structures under barrows.

5160±70 BP (3210 bc) GU-2760

5070±50 BP (3120 bc) GU-2761

The two dates are on oak charcoal from the fence round the enclosure, so some old wood effect may be expected, though the closeness of the dates suggests they are fairly reliable.

This evidence is supplemented by less secure dates from four other sites. Those from Tulloch of Assery B (N/ND1), Thurso, and Midtown of Pitglassie (N/NJ2), Turriff, are on burial monuments.

4965±60 BP (3015 bc) GU-1332 Tulloch of Assery B

4935±105 BP (2985 bc) GU-2014 Midtown of Pitglassie

The date from Tulloch of Assery B chambered cairn is on bone from the burial chamber, and with its small error, appears to be as relevant and reliable as a single dates can be. It indicates a Neolithic presence in the very north of Scotland no later than that further south. The Midtown of Pitglassie date is on charcoal from various short-lived species, recovered from a cremation pit stratigraphically earlier than the ring cairn. Shepherd (unpub.) assumes that the cremation pits are closely associated with the main cairn construction, and that GU-2014 dates the construction of the cairn. A date of :-

4660±50 BP (2710 bc) GU-2049

from charcoal from the edge of the outer ring of stones overlaps with GU-2014 at two standard deviations, and may imply that the real date for the cairn is actually fairly late. However, GU-2049 is stratigraphically much less secure than GU-2014, and is more probably associated with activity later than the construction of the cairn.

The dates from Raigmore (N/NH1), Inverness, are from cremation pits outside the kerb of the Clava cairn.

5000±100 BP (3050 bc) SRR-424

4983±130 BP (3033 bc) SRR-188

It is therefore hard to firmly associate these with the cairn, but pottery from the pits suggests they are Neolithic.

At Pitnacree (N/NN1), Aberfeldy, a date on a charcoal spread provides a *terminus post quem* for pre-barrow features:-

4810±90 BP (2860 bc) Gak-601

In association with pottery, and evidence for cultivation were two large post holes, whose posts appeared to have rotted *in situ*, implying a considerable length of time before the area was covered by the charcoal spread.

The average of dates from this region, using the combined date for Balbridie, and the two dates on the earlier features at Boghead, gives the start of the Neolithic between 3079-3007 bc (3933-3705 cal.BC). This date falls in the same period as estimates for the west and south of Scotland, suggesting that full Neolithic culture reached the north of Scotland no later than the south or west. This counters the model of an influx of ideas or people from the south-east and west, but again the very few dates available must be emphasised.

Area D

(Figure 3.9)

This area covers north-west and central England, and is dominated by the concentration of Mesolithic sites on the Pennines, but also includes some lowland sites. The Neolithic sites, all occupation sites, appear to be restricted to the lowlands. While these few sites may not be representative, the insubstantial nature of both Mesolithic and Neolithic sites implies that similar factors of discovery and preservation should act on them.

The Pennines have long been known for the density of flint scatters, and the growth of peat allowed the preservation of very slight occupation traces that would not remain elsewhere (Jacobi *et al* 1976). It is, therefore, one of the few areas where *in situ* Mesolithic remains may be found for dating, yet there is no reason why Neolithic sites

should not also be preserved. The long tradition of field work in this area has produced far less Neolithic than Mesolithic material. Perhaps Neolithic activity was genuinely concentrated away from the hills (Barnes 1982, Leach 1951).

The work of Switsur and Jacobi (1975) on dating the Mesolithic of the Central Pennines has produced some important fourth millennium dates. Four sites on the moors round Marsden produced late dates, suggesting activity in this area throughout the first half of the fourth millennium bc.

6020 \pm 220 BP (4070 bc) Q-1188 March Hill II

5850 \pm 80 BP (3900 bc) Q-788 March Hill II (M/SE4)

5830 \pm 100 BP (3880 bc) Q-1190 Rocher Moss II (M/SE5)

5610 \pm 120 BP (3660 bc) Q-1189 Lominot IV (M/SE3)

5380 \pm 80 BP (3430 bc) Q-799 Dunford Bridge B (M/SE2)

However, Jacobi (1987 and pers. comm.) now considers these dates to be unreliable because of their poor contexts. He believes the date from Dan Clough (M/SE1) to be a better indication of the latest Mesolithic in this area, as well as the latest reliable Mesolithic date for Britain.

5750 \pm 70 BP (3800 bc) GrN-12278

The sample is from a stone-built hearth, and therefore from a fairly undisturbed context.

The acid environment of the moors prevents the preservation of bone, so the dates are necessarily on fragments of charcoal. The repeated occupation of some of these sites could result in the disturbance of earlier layers, and the mixing of artefacts and charcoal of different periods. However, this would only lead to the contamination of later deposits by older charcoal from previous occupations, so the younger dates should be fairly reliable. Contamination by later peat acids could be possible, but samples were pretreated specifically to reduce this risk.

At Williamson's Moss (M/SD2), Cumbria, both Mesolithic and Neolithic artefacts were present. Six dates come from timber structures and the related old land surface. 5 are on small branches, twigs and bark and all these have very small errors.

5650±50 BP (3700 bc) UB-2546 structure 1

5555±40 BP (3605 bc) UB-2545 structure 1

5520±85 BP (3570 bc) UB-2712 ~~old land surface~~ bark floor

5500±70 BP (3550 bc) GU-1664 ~~old land surface~~ bark floor

5480±90 BP (3530 bc) UB-2713 structure 2

An earlier date from structure 1 is probably anomalous as it was on oak, presumably heartwood.

6015±75 BP (4065 bc) UB-2544

These dates are augmented by a dated pollen core. However, no artefacts of any sort were found with the timber, platform-like structures, so the dates are not directly related to the Mesolithic assemblages found elsewhere on the site. It cannot be assumed that these structures were constructed by people using Mesolithic assemblages, rather than Neolithic ones, as both industries are present in the area.

A later date (N/SD1) also came from the site from charcoal in a hearth.

4925±165 BP (2975 bc) UB-2711

It has a large error and was not closely related to diagnostic artefacts, but there is pottery and diagnostic Neolithic flint work ~~in this area of~~ ^{on} the site. This date therefore is probably associated with an occupation event later than that which produced the platforms.

Other early Neolithic activity in the area is dated at Plasketlands enclosure (N/NY1), Cumbria.

5090±60 BP (3140 bc) GU-2572

4940±90 BP (2990 bc) GU-2573

4810±60 BP (2860 bc) GU-2571

The dated charcoal came from two large post-holes, external to the ditched enclosure. GU-2571 and 2573 were from the same pit and have a weighted average of 4850 ± 50 BP (2800 bc).

An early date from Ehenside Tarn (R10), just north of Williamson's Moss:-

4964 ± 300 BP (3014 bc) C-462

has been rejected because of its large error. It was from a possible structure of dubious association with Neolithic pottery. Other dates from this site are later, and it is unfortunate that no more work has been carried out here to resolve stratigraphical problems on this site, which has been claimed to be a finishing site for Langdale axes, and therefore of wider interest (Darbishire 1874).

Further south, in Derbyshire, two features from the site of Lismore Fields (N/SK3), near Buxton, were dated to the late fourth/early third millennium bc. These included a timber building with 4 dates from post-holes with a weighted mean of:-

4923 ± 35 BP (2973 bc)

These dates were on short lived timbers and charred seeds, and were all very close, suggesting that the dates can be accepted with some confidence. A single date of:-

5270 ± 100 bp (3320 bc) OxA-2433

came from a post-hole associated with a ring slot. The date was on mixed charcoal, and considerably earlier than other similar dated ring slots on the site, so its reliability may be questionable.

Other rather isolated Neolithic sites have been included in this region. Little can be concluded from their single or divergent dates except to suggest the extension of early Neolithic activity into areas with no other isotopic dating evidence. The date from Beeston Castle (N/SJ1), Cheshire:-

5140 ± 90 BP (3190 bc) HAR-6462

is from a primary ditch fill, and is stratigraphically consistent with other, later

dates. The sites of Liffs Low (N/SK2) and Hognaston (N/SK1), Derbyshire, both produced single dates from Neolithic pits under later barrows.

5000±80 BP (3050 bc) OxA-2290 Liffs Low

4930±60 BP (2980 bc) BM-2421 Hognaston

The Hognaston pit contained a Neolithic vessel, but the presence of artefacts is not mentioned for the Liffs Low pit.

Brushwood from an ancient river channel near Castle Donnington (R6), Leicestershire, was dated:-

5240±70 BP (3290 bc) HAR-8223

This may be the remains of a fish weir, similar to one found in a neighbouring channel, and dated:-

6720±70 BP (4770 bc) HAR-8508

But the excavator believed it more likely to be naturally deposited material (Salisbury 1988).

A late survival of the Mesolithic culture on the Pennines seems possible, but the dating evidence is, as ever, inadequate to support this. Williamson's Moss suggests a merging of Mesolithic into Neolithic with little overlap. However, traditional Mesolithic groups could have lived in the Pennines while a fully developed Neolithic culture built barrows in the eastern lowlands. A date of 3060-2972 bc (3900-3698 cal.BC) can be suggested for the earliest recognisable Neolithic in this area, using dates from Plasketlands, both features at Buxton, Beeston Castle, Hognaston, and Liffs Low.

Area E

(Figure 3.10)

This area covers Wales, which has relatively few sites dated to the fourth millennium bc, all of which have single dates. The pattern of Neolithic dates is much the same as elsewhere, similar dates from both monuments and occupation sites falling in the last quarter of the fourth millennium. Even though the central date from Llandegai

(N/SH2), Gwynedd, might suggest it is a little earlier than the others it has a large error, and it seems possible that the true date should fall in the later half of the date range.

5240±150 BP (3290 bc) NPL-223

The date from Brenig Valley (O/SH1), Clywd, came from a pit containing no diagnostic artefacts.

5120±100 BP (3170 bc) HAR-1436

The only clearly Mesolithic flints in the area were from a pit securely dated as Mesolithic, and there is no reason to associate the other pits and post-holes with this industry (Jacobi 1980).

There are only two fourth millennium, Mesolithic dates from Wales, both from Dyfed. The one from Freshwater West (M/SR1) is too early to be controversial.

5960±120 BP (4010 bc) Q-530

The date on a pig vertebra associated with two microliths from the submerged land surface at Lydstep (M/SS1):-

5300±100 BP (3350 bc) OxA-1412

is one of the latest Mesolithic dates, though the unreliability of single dates must be remembered.

While this date does overlap with many of the Neolithic dates at two standard deviations, this alone cannot be taken to prove contemporaneity between Neolithic and Mesolithic cultures. If water travel was important during the Neolithic, as seems probable, there is no reason why west Wales should have been particularly isolated from developments in the rest of the country. The average for all the Neolithic dates is 3084-2980 bc (3933-3700 cal.BC).

Area F

(Figure 3.11)

This area covers counties up the eastern side of England, including Cambridgeshire, Norfolk, Lincolnshire, Humberside, the eastern part of North Yorkshire, and Cleveland. The east of England lacks any dating evidence for the end of the Mesolithic, though late Mesolithic occupation is known from the region (Jacobi 1984,

Tilley 1979). Mesolithic lithic scatters were also found on some of the catalogued sites e.g. Spong Hill (N/TF4) and Peacock Farm (N/TL4). While the dating evidence for the Neolithic is sparse, much of it was carried out recently, so errors on most dates are relatively small, and though hardly well dated, most sites have at least two dates. The region incorporates several counties up the east coast of England, but I have also included some sites further inland that seemed to fit most neatly with this group. Sub-groups of sites have been named after the county in which most of the sites fall.

In figure 3.11a and b the sites have been listed roughly south to north, graphically illustrating that no movement of the Neolithic culture up the east coast can be discerned from the dating evidence. Almost all the dates are very close, despite being from both funerary and occupation sites. The single exception seems clearly out of place, and is almost certainly anomalous.

This exception is the early date from Broome Heath (N/TM1), Norfolk. There are two dates from the pre-enclosure phase, and both are associated with similar pottery, but there is a vast difference between the dates.

5424±117 BP (3474 bc) BM-679

4167±78 BP (2217 bc) BM-755

BM-755 is later than those from the enclosure, and it is therefore probably anomalously young, explaining some of the difference between the dates. BM-679, however, is on oak charcoal, and therefore possibly too old. More importantly both samples come from the preserved soil profile, and not from a sealed context in a feature. The origin of both samples is therefore insecure, and they may not be related to the activity which produced the pottery.

The south part of area F covers sites grouped in Cambridgeshire and Norfolk, with a couple of outliers. Unusually most dated sites in this sub-group are occupation sites. Spong Hill (N/TF4), Norfolk has two dates on Neolithic settlement remains discovered while excavating later, mainly Saxon, features. One is on bulked charcoal and charred acorns of very insecure provenance, and can only give a general, inaccurate date for scattered post-holes, which may have been produced over a considerable time-span.

4950±120 BP (3000 bc) BM-1534

The second date is rather more reliable, as it comes from a single feature, and was associated with pottery.

4990±80 BP (3040 bc) BM-1535

Little Waltham (N/TL3), Essex, is another site where excavation of later features revealed slight evidence of settlement at this period. A date was determined on charcoal from a hearth associated with two linear features and early pottery:-

5120±130 BP (3170 bc) HAR-1087

At Peacock's Farm (N/TL4), Cambridgeshire, the occupation deposits were closely associated with peat cores, which were subjected to pollen analysis revealing vegetational disturbances. Q-527/8 and Q-525/6 are each amalgamations of two charcoal samples making them very generalised. The close relationship of the dates produced by the Cardiff and Cambridge laboratories implies minimal laboratory error.

4970±80 BP (3020 bc) CAR-790

4950±120 BP (3000 bc) Q-527/8

4870±120 BP (2920 bc) Q-525/6

The date from Grendon (N/SP2), Northamptonshire:-

4950±80 BP (3000 bc) HAR-1498

is from a posthole, part of a possible post circle under the square ditch, known as Grendon C.

At Eaton Heath (N/TG1), Norfolk, a series of deep features, possibly shafts with some ritual function were discovered. These were dated to the late Neolithic, but one fourth millennium date was produced from a bulk sample of charcoal from an adjacent pit.

5095±49 BP (3145 bc) BM-770

This could imply the presence of a late fourth millennium domestic site reused for later ritual purposes.

Charcoal from the rectangular structure at Fengate (R11), Cambridgeshire, produced one fourth millennium bc date, but a much later date also came from the same context.

4960 \pm 64 BP (3010 bc) Gak-4196

4395 \pm 50 BP (2445 bc) Gak-4197

The context seems undisturbed, so contamination by younger material seems less likely than Gak-4196 being on old heart wood. This implies that the real date for this structure is closer to the later date, and so this determination is excluded from this study.

Further north the dated sites are almost all long barrows, the only exception being Tattershall Thorpe (N/TF5), Lincolnshire, where a pit related to the Neolithic settlement of the site produced a date of:-

5100 \pm 50 BP (3150 bc) HAR-4638

A much earlier date from the site is either anomalous or related to Mesolithic settlement:-

5820 \pm 60 BP (3870 bc) HAR-4639

Giant's Hill 2 long barrow (N/TF2), Lincolnshire, was sufficiently well dated to distinguish the construction of the mortuary structure and the mound as separate events, with some considerable time between them. Many excavations have revealed these to be stratigraphically separate events, but very few have sufficient dated contexts to suggest their actual chronological separation. One date on charcoal from the facade trench:-

5450 \pm 80 BP (3500 bc) OxA-641

was considered to be excessively old compared to the three reliable dates, and was probably on old wood. Another fourth millennium date came from the quarry ditch, and as this must have been contemporary with the third millennium mound construction, the date was too early for the context:-

5090 \pm 80 BP (3140 bc) HAR-1869

This could be explained if the antler dated had been residual from the mortuary structure phase, but the sample was very small, and the laboratory reported that it had caused problems during dating.

It is interesting to note how close the three accepted dates from the mortuary structure are despite being produced by two different laboratories.

5140±80 BP (3190 bc) OxA-642 facade trench

5100±80 BP (3150 bc) CAR-821 post-hole

4970±100 BP (3020 bc) CAR-822 post-hole

The context of these dates is also quite good, the origin of the charcoal being most probably the posts of the facade and mortuary structure. The post-holes of the latter suggest that the posts were probably half trees, and as the charcoal is oak, old wood effect may be suspected. However, the date from the facade trench is on *Crataegus* charcoal, which is a shorter lived species. The facade and mortuary structure are stratigraphically contemporary, so any old wood effect seems to be no greater than the error on the dates.

Fourth millennium bc dates from the lower ditch fills of long barrows at Ash Hill (N/TF1) and Hoe Hill (N/TF3), Lincolnshire, provide supporting evidence for early monuments, as do the two dates on the mortuary chamber in Haddenham long barrow (N/TL2), and a similar date from Haddenham causewayed enclosure (N/TL1), Cambridgeshire.

4970±100 BP (3020 bc) HAR-9449 Ash Hill

4930±100 BP (2980 bc) HAR-6400 Hoe Hill

4950±70 BP (3000 bc) HAR-9175 Haddenham, long barrow

4930±60 BP (2980 bc) HAR-9174 Haddenham, long barrow

4970±90 BP (3020 bc) HAR-8092 Haddenham, enclosure

A concentration of dated long barrows lies in the vales of York and Pickering, with Street House long barrow to the north on the Cleveland coast. Street House (N/NZ1) is another of the rare, well dated fourth millennium sites. Its dates unfortunately suffered from the British Museum laboratory's systematic errors between 1980 and 1984 (Bowman *et al* 1990), so the dates were first published as late Neolithic. There are 9 revised dates, which are all very similar and extend into the fourth millennium bc, though the corrections

have given them unfortunately large errors. The errors of the average dates are only small because the process of combining dates reduces the error.

5026 \pm 50 BP (3076 bc) average date for facade

4960 \pm 85 BP (3110 bc) average date for old land surface

4945 \pm 47 BP (2995 bc) average date for chamber

BM-2013R (4840 \pm 130 BP (2890 bc)) is slightly later than the majority and BM-2061N (5080 \pm 60 BP (3130 bc)) a little earlier, though both overlap considerably with the other dates, and they cannot be considered anomalous.

The other barrows have similar dates, and such close dating suggests a relatively secure start date for the monument type in this area. East Heslerton long barrow (N/SE2), North Yorkshire, has three dates from the facade trench with an average of 4990 \pm 50 BP (3040 bc).

Two very close dates come from cremation burials at Garton Slack 37 long barrow (N/SE3), Humberside.

5060 \pm 150 BP (3110 bc) NPL-195

5045 \pm 150 BP (3095 bc) NPL-194

These are stratigraphically later than the long barrow, though the errors are large, and the date of the long barrow probably falls within the range of these dates.

Raisthorpe Manor long barrow (N/SE4), North Yorkshire, has a date from the facade trench:-

5070 \pm 60 BP (3120 bc) HAR-8783

Another date, also from the facade would appear to be anomalously early compared to HAR-8783 and dates on the other long barrows in the county:-

5505 \pm 145 BP (3555 bc) NPL-140

The dates from Garton Slack and Raisthorpe Manor dated by the National Physics Laboratory were measured many years ago. The laboratory is no longer functioning so it is not possible to compare past and present performance. Methods and the degree of testing to ensure reliable results have improved considerably in recent years,

and dates measured before these improvements took place should be considered with some suspicion.

Two fourth millennium dates came from Willerby Wold long barrow (N/TA4), North Yorkshire:-

4960 \pm 150 BP (3010 bc) BM-189

4900 \pm 150 BP (2950 bc) BM-188

in association with the earliest burials under the crematorium deposit.

Barrows at Ayton (N/TA1) and Whitegrounds (N/SE5), North Yorkshire, and Callis Wold (N/SE1) and Grindale (N/TA2), Humberside, have similar, though single dates.

5030 \pm 90 BP (3080 bc) NPL-73 Ayton East Field

4933 \pm 64 BP (2983 bc) BM-1170 Callis Wold

4910 \pm 120 BP (2960 bc) HAR-269 Grindale I

4950 \pm 90 BP (3000 bc) HAR-5580 Whitegrounds

Seamer Moor, barrow 1 (N/TA3), North Yorkshire, has two dates from separate features, which are not very secure dates, but support the general dates suggested by the other sites:-

5260 \pm 100 BP (3310 bc) HAR-8785 Date on hearth beneath the mound.

4990 \pm 90 BP (3040 bc) HAR-8786 Date on grave pit.

Though HAR-8785 provides a *terminus ante quem* date for the mound, the brief report in Radiocarbon does not mention associated Neolithic artefacts, so its usefulness in dating early Neolithic assemblages is doubtful.

Weighted averages for the different sub-groups are as follows:-

Subgroup F1 3064-2944 bc (3901-3693 cal.BC), includes dates from Broome Heath (BM-679), Spong Hill (BM-1535), Little Waltham, Peacock Farm, Eaton Heath.

Subgroup F2 3184-3024 bc (3978-3724 cal.BC), includes dates from Tattershall Thorpe (HAR-4638, Giants Hill (OxA-642, CAR-821, CAR-822), Ash Hill, Hoe Hill, and Haddenham long barrow and enclosure.

Subgroup F3 3083-2963 bc (3932-3697 cal.BC), includes dates from Garton Slack, Willerby Wold, Ayton, Whitegrounds, Callis Wold, Grindale, Raisthorpe Manor (HAR-8783), Seamer Moor (HAR-8786), and Street House.

These are all obviously very close with no reason to suggest a later adoption of the Neolithic culture in any one area. The combined average for the region is 3077-3021 bc (3934-3708 cal.BC). The number of dates used to calculate this has resulted in a deceptively small range, but this should not be considered any more precise than the other estimates.

The absence of Mesolithic dates for this area makes even the usual tentative statements impossible, but it seems unlikely that the fenlands were abandoned by hunter-gatherers, and future dating of Mesolithic sites in this region may be expected to produce dates at least as late as those from the Central Pennines.

Area G

(Figure 3.12)

This area covers most of south-east and south central England. Though this area has far more dated, early Neolithic sites than any other, many of these only possess a single date, and few individual sites are securely dated. However, if dates from various types of sites can be assumed to corroborate each other the early Neolithic as a period is fairly well dated. Neolithic dates with a median as early as 3400 bc are restricted to south-east England. The three earliest dates are from Court Hill enclosure (N/SU6), Lambourn long barrow (N/SU11), and Church Hill flint mine (N/TQ2), but all these are single dates with little other evidence to support them. The last two were dated some time ago and the quality of these may be questioned.

5420±180 BP (3470 bc) I-12893 Court Hill

5365±180 BP (3415 bc) GX-1178 Lambourn

5340±150 BP (3390 bc) BM-181 Church Hill

The date from Lambourn was on a small patch of charcoal in the south ditch, and may have been residual or from old heart wood. The Court Hill date is on bone, but the

sample was rather small for dating, which explains the large error. At Church Hill an artefact, an antler pick, was dated directly, so there is a good relationship between the date and the cultural activity. However, in all three cases the large errors mean that the true dates could fall considerably later than the median. It is thus hard to argue for an early start to the Neolithic just from these dates.

Of the other sites some are fairly well dated, most notably Hazleton North long cairn (N/SP3), Gloucestershire. Saville *et al* (1987) have considered the problems raised on such an extensively dated site. The dates from Hazleton can be combined to suggest a single event occurring around 4885 ± 16 BP (2935 bc). The earliest and latest dates both seem slightly out of sequence.

5200 ± 150 BP (3250 bc) OxA-912

4450 ± 90 BP (2500 bc) OxA-383

However, even if these are rejected the dates cover a span of 630 years at two standard deviations, and it seems more reasonable that the tomb was used over some time. Dates from the north chamber, especially when calibrated are slightly later than those from the south chamber. Although this could not be statistically supported, it does agree with the stratigraphy. The construction and earliest burials could therefore have taken place at the end of the fourth millennium bc (Saville *et al* 1987).

Ascott-under-Wychwood (N/SP1), Oxfordshire, is another dated Cotswold-Severn barrow with three accepted dates from the mound, and one from a pre-barrow occupation phase. The date from the ditch has been rejected because of its excessive error.

5198 ± 224 BP (3248 bc) BM-835

Despite some doubt being expressed by the excavator (Benson 1971), the mound dates are fairly close and seem to support each other well.

5020 ± 92 BP (3070 bc) BM-833

4942 ± 74 BP (2992 bc) BM-832

4930 ± 100 BP (2980 bc) BM-1976R

BM-1976R is on a human bone from the burial, and so is unlikely to be residual as the excavator initially feared the charcoal dates were. The date on the pre-mound occupation

4893±70 BP (2943 bc) BM-491b

is statistically indistinguishable from the mound dates, and implies the occupation occurred a short time before the mound construction.

Harrow Hill (N/TQ3), West Sussex, has 6 dates from the chalk fill of one shaft, and another date from an earlier excavation. Each mine shaft probably represents the work of one season, and was filled in at the end of that season (Gardiner 1990), so the dates represent a single phase of activity. As they all overlap at one standard deviation it is justifiable to combine them resulting in a weighted average of 5047±50 BP (3097 bc)

Long Down flint mine (N/SU12), West Sussex, Mount Farm (N/SU13), Buckinghamshire, and Runnymede Bridge (N/TQ5), Surrey, each have two very close dates¹⁹ with smaller errors.

5050±100 BP (3100 bc) OxA-1152 Long Down

4900±100 BP (2950 bc) OxA-1151 Long Down

5120±110 BP (3170 bc) HAR-4819 Mount Farm

5030±90 BP (3080 bc) HAR-4821 Mount Farm

4930±70 BP (2980 bc) HAR-6131 Runnymede Bridge

4920±80 BP (2970 bc) HAR-6128 Runnymede Bridge

The last two are occupation sites, which complement the many dates on flint mines and monumental structures.

The Trundle (N/SU14), West Sussex, also has two dates, and though they are on

19. See footnote 18 p71.

different layers of the ditch fill they agree with the stratigraphy, and might be considered to support each other to some extent.

5240 \pm 140 BP (3290 bc) I-11615 layer 4

4860 \pm 100 BP (2910 bc) I-11612 layer 3

The other sites in the region generally support the dates from these more reliably dated sites. The Coneybury pit (N/SU4), Wiltshire, is worth mentioning, despite having only one date.

5050 \pm 100 BP (3100 bc) OxA-1402

The excavator (Richards 1990) felt that the primary deposit, packed with pottery, bones and flint, had been laid down over a short time-span. The nature and condition of pottery and faunal deposits give some support to this. The date is on a fresh, stratigraphically secure bone, which has butchering marks, further associating it with the mass butchery event that seems to have occurred. While contamination and measurement errors cannot be assessed because there is only one date available, the potential archaeological error seems to be minimal.

The site is of importance because of the high proportion of wild fauna in the assemblage, especially roe deer, and the technological emphasis on blade production, unlike near-by, slightly later, early Neolithic sites. Richards (1990) is inclined to see this as a Transitional site, with the use of pottery and domestic animals, but considerable reliance on wild resources and a technology possibly adapted to a more mobile lifestyle. Unfortunately the probable special, or ritual, nature of the site suggests it may be atypical, the wild fauna and blade technology not necessarily a normal part of the economy or material culture. This site has been classed in this study as early Neolithic because of the presence of pottery, but it is a good example of the problems of classification when artefactual and economic evidence suggests a situation less clear cut than the usually accepted dichotomy of sedentary Neolithic farmers, and mobile Mesolithic hunter-gatherers.

It is very hard to give a meaningful average for the early Neolithic dates of this area largely because of the greater number of dated sites. Dates in the classes of enclosures and funerary monuments can be split tentatively into earlier and later groups. It is notable that the more securely dated sites all fall in the latter category. The early barrow dates in particular overlap considerably with the later ones, and possibly represent contemporary activity. However, the two groups are from discrete areas, and contain

different classes of barrows. Both Cotswold-Severn barrows have a combined date of 2936-2906 bc (3775-3640 cal.BC), significantly later than the three Wiltshire barrows, 3426-3114 bc (4240-3818 cal.BC). The chronological difference may therefore be real. Only a greater number of more precise dates will resolve this.

Mines and occupation sites have dates with a large degree of overlap, and combined dates for these give a general indication of the start of the Neolithic in the region. The flint mines (excluding Church Hill) have a combined date of 3175-3023 bc (3975-3720 cal.BC), and the occupation sites a combined date of 3054-2954 bc (3899-3695 cal.BC). This suggests that Neolithic activity in this area is no earlier than in any other. These estimates should be considered too precise, as the use of very different dates from different contexts means that no real reduction in error is achieved by this calculation.

Jacobi doubts that there are any genuine Mesolithic dates for the fourth millennium from southern England, though perhaps not all can be rejected as easily as he claims (Jacobi 1982). Wawcott Farm I (M/SU3), Berkshire:-

5260 \pm 130 BP (3310 bc) BM-449

has one of the latest dates, later than the dates from Lambourn and Court Hill. Jacobi (1982) points out that the dated hearth is in the upper fill of a possible Mesolithic hut, and not associated with its use. However, if all the Mesolithic flints associated with this hearth were residual it means the site was occupied, however briefly, without any flints being dropped. The date may relate to the flints, but it must be emphasised that very little weight can be placed on a single date. In this case the relationship between the dated material, and diagnostic artefacts is far from firm.

An antler mattock of Mesolithic type, from Staines (O/TQ2), in Surrey, has produced a date which is not statistically different from the Wawcott Farm date.

5350 \pm 100 BP (3400 bc) OxA-1158

The Staines mattock is of additional interest because of the implication that bone and antler working may not have ceased during the late Mesolithic in England as Jacobi (1982) has claimed. However, the other dated Mesolithic antler or bone artefacts are all considerably earlier, or from Obanian sites (Bonsall and Smith 1989). The date from the Staines mattock falls well within the range of Neolithic dates for this region, and a hiatus in bone working in southern England could still be argued, with its reintroduction in the Neolithic. A Bronze Age date on a similar mattock from Wallsend could help support this suggestion of a late tradition of mattocks (Bonsall and Smith 1989). Clearly the evidence is

too slight to argue either way, but more dates are needed to establish the cultural identity of antler mattocks before this particular example can be used to date the end of the Mesolithic.

A pit on Charlwood site I (M/TQ1), Surrey, produced a series of dates from the lower levels of the fill. These form a neat sequence, but their relationship to Mesolithic artefacts in the pit is not specified, so it cannot be determined which, if any of these can be assumed to date this activity.

5640 \pm 90 BP (3690 bc) HAR-4533 40-45cm from top of pit

5270 \pm 90 BP (3320 bc) HAR-4532 35-40cm from top of pit

4340 \pm 100 BP (2390 bc) HAR-4531 30-35cm from top of pit

Other late Mesolithic dates from area G are rather earlier.

6040 \pm 110 BP (4090 bc) HAR-4475 Longmoor site I (M/SU1)

5890 \pm 100 BP (3940 bc) BM-2404 Stratford's Yard (M/SP1)

5680 \pm 120 BP (3730 bc) HAR-233 Wakefords Copse (M/SU2)

More dates are clearly needed to confirm the late survival of the Mesolithic in this region, as the present dates are inadequate to support any such claim.

The dates from features with mixed or no cultural indicators can be compared to the dates with more secure cultural associations. Gallibury Down (O/SZ1) on the Isle of Wight produced a mid fourth millennium bc date from a post-hole.

5330 \pm 110 BP (3380 bc) BM-2231R

There were no associated artefacts, and as the date corresponds to the earlier part of the Neolithic range there is no reason to assume that this did not represent Neolithic pre-barrow activity.

The butchery activity demonstrated by the dated bone from Tolpits Lane (O/TQ3), Hertfordshire, could have been carried out by people of either tradition.

5540±110 BP (3950 bc) BM-1676R

However, the date is rather early compared to the majority of Neolithic dates, and it seems more likely to represent Mesolithic activity.

High Rocks (O/TQ1), Kent, is more problematic as it is described as a "transitional" site possessing both artefact traditions (Money 1960, 1962). The radiocarbon dates suggest a Mesolithic date.

5730±150 BP (3780 bc) BM-91

5650±150 BP (3700 bc) BM-40

However, the analysis of a mineral soil profile from the site showed the presence of beech pollen throughout the profile. Beech is generally assumed to be present in Britain only from the Neolithic (Godwin 1975 p273-274, Huntley and Birks 1983 p204-206), and the presence of its pollen implies a Neolithic or later date. Movement of pollen grains down through the soil is probable, making it impossible to relate pollen and archaeological evidence, however, thermoluminescence(TL) dates on the pottery also suggested a Neolithic date, though TL dating is even less precise than radiocarbon (Jacobi 1982). Even though the dated hearths seemed undisturbed it is likely that mixing of successive occupation phases had occurred, and that the dated charcoal was from the Mesolithic occupation of the site. Evidence for an overlap of Mesolithic and Neolithic activity in area G is very slight, though this is mainly due to the poverty of ultimate Mesolithic dates.

Area H

(Figure 3.13)

Area H covers south-western England, from Somerset and Dorset west. Neolithic activity is clearly demonstrated in the Somerset Levels by about 3150 bc, as the Sweet track (N/ST5) is the most securely dated feature in this catalogue. There are 10 individual radiocarbon dates on wood from the track, of which two have been rejected from the catalogue because they are too young.

4940±150 BP 2990 bc) HAR-1473

4887±90 BP (2937 bc) Q-991

HAR-1473 was younger than expected from its place in the tree ring series. Q-991 is anomalously late compared to the other dates, and there was some confusion about the source and nature of the dated material.

Many of these dates came from hazel and ash pegs, rather than the oak planks of the track, so the old wood effect is ruled out. There are also 6 dates on peat from directly under and over the track. 4 of these agree very well with the timber dates, but two are considerably later:-

4744 \pm 45 BP (2794 bc) SRR-882

4405 \pm 45 BP (2455 bc) SRR-881

and possibly suffer from a systematic error that appears to make SRR dates for many Somerset Levels sites too young (Orme 1982).

In addition there is a date on peat from near by site on Shapwick Heath (N/ST4), where Neolithic stone axes were found.

5510 \pm 120 BP (3560 bc) Q-423

This is much earlier than the Sweet Track dates, and while it may represent earlier Neolithic activity in the area, it seems more probable that this is an anomalous date.

Accepted dates on the Sweet Track can be combined as archaeological and stratigraphical evidence suggests that it is a single phased structure. The average of these 12 peat and timber dates is:-

5129 \pm 23 BP (3179 bc) 3995-3821 cal.BC

This may seem a very precise and accurate date compared with the majority in this catalogue, but the excellent preservation has allowed even more accurate dates to be produced. Dendrochronological studies (Hillam *et al* 1990) have tied the series of tree rings from the Sweet Track into a national dated series, allowing dating of Sweet Track timbers. 4 planks, as well as round wood timbers, retained their bark or sapwood, and the year that these were felled could be found by matching their tree ring patterns to a national tree ring sequence. Nearly all these timbers had been felled in winter or early spring or 3807/6 ABC. Two timbers were felled later in 3804 and 3800 ABC, but these were probably the result of repairs to the track. All the timber for the track, therefore, seems to have been felled at one time, and construction probably occurred soon after in one episode.

The Post Track (N/ST3), which was discovered directly under the Sweet Track, was dated by dendrochronology to 3838 ABC. In this case the felling of the trees possibly occurred some time before the construction of the track. The Post track is much simpler than the Sweet Track, and there is no intervening peat accumulation between the two suggesting that it was a working platform built to enable the construction of Sweet Track. The use of old timber lying on the fen, or from an earlier structure, for this purpose seems likely (Hillam *et al* 1990).

Dendrochronology is completely independent of radiocarbon dating, which is why it is used to create calibration curves. It is also completely accurate, unless there is a fault in the construction of the main sequence. The construction of the Sweet Track can therefore be dated with some confidence to the spring of 3806 ABC (i.e. calendar years BC). The calibrated weighted mean of the Track dates does not quite overlap with this at two standard deviations. Many of the individual calibrated dates do overlap with the dendrochronological dates, suggesting that combining dates may excessively reduce the error (see figure 3.14). It is also a good example of the danger of quoting only central dates. Though the dendrochronological date falls within the range of the radiocarbon dates, it is clearly not related to the central dates, and the use of these without the errors would give a falsely early impression of the date of the track.

Other dated sites, both Neolithic and Mesolithic, are sparse and poorly dated in the south-west. Several of the dated Neolithic sites are hill top settlements. Though the nature of these varies considerably, it may be possible to consider them as a roughly contemporary group with the more reliably dated sites supporting poorer dates on others. The settlements at Carn Brea, Hembury and Maiden Castle were enclosed. While the latter may be classed with those enigmatic monuments, causewayed camps, Carn Brea, Cornwall (Mercer 1981a) at least, was enclosed for the purpose of defence, as the large number of arrowheads testifies. There is an enclosure on Hazard Hill, Devon (Houlder 1963), but the occupation area is outside this, and the excavator suggests the enclosure was a cattle pen. High Peak, Devon, also had the remains of a ditch, but this was too badly damaged by later activity for much to be deduced about the plan of the site (Pollard 1966).

Maiden Castle (N/SY2), Dorset, is the best dated of the enclosed sites, with four dates on the early occupation of the enclosure (BM-2450 and the recount of the same sample have been combined.)

5040 \pm 60 BP (3090 bc) BM-2449 charcoal

5032 \pm 38 BP (3082 bc) BM-2450/A charcoal

5030 \pm 80 BP (3080 bc) OxA-1337 human bone

4930 \pm 90 BP (2980 bc) OxA-1338 human bone

These are on charcoal and human bones from the primary fill of the ditch. Dates on the two materials compare very well, suggesting minimal old wood effect, despite the charcoal being identified as mature oak.

The origin of material in a ditch fill can rarely be reliably known, it could be residual, refuse from earlier occupation phases as proposed at Abingdon (Avery 1982), and not necessarily contemporary with the filling of the ditch. Recutting and deliberate backfilling is evident in some Neolithic ditches, making it possible that even material lying on the bottom of the ditch is not necessarily primary material and may date a later recutting, not the original construction of the ditch (Mercer 1980). Experiments have shown how turf, falling from the ditch side, may also introduce artefacts and datable material that are much earlier than the construction of the ditch (Jewell and Dimbleby 1966). Many ditches in southern England are filled with loose chalk rubble, and there must be a risk of artefacts and organic material moving down through the spaces in the rubble (Mercer 1980). Dates from any ditch should be treated with caution, and the validity of combining dates from a ditch is therefore dubious. However, the closeness of the Maiden Castle dates suggest the material originated from the same episode, and their combination is tempting. The weighted average of these dates is:-

5024 \pm 28 BP (3074 bc)

Hembury (N/ST2), Devon has three dates which appear to corroborate each other, but these all have large errors.

5280 \pm 150 BP (3330 bc) BM-138

5190 \pm 150 BP (3240 bc) BM-136

5100 \pm 150 BP (3150 bc) BM-130

Though BM-138 is stratigraphically later than BM-130 they overlap at one standard deviation, making them statistically indistinguishable, and the date inversion apparent at first glance is not significant.

Carn Brea (N/SW1) has three dates, two mid third millennium bc, and the fourth millennium one:-

4999 \pm 64 BP (3049 bc) BM-825 Carn Brea

The relationship of these does not contradict the stratigraphy so they are probably relatively reliable.

Two dates came from the primary deposit in the ditch at Hambledon Hill (N/ST1), Dorset:-

4840 \pm 150 BP (2890 bc) HAR-1886

4560 \pm 90 BP (2610 bc) HAR-1802

The later date is similar to others from pits dug into the fill when the ditch was largely filled in, making the earlier date possibly the most accurate date for the primary deposit. However, the ditch had been recut and backfilled, and it possible that all the dated material might be residual, and a clear relationship to the construction of the ditch seems very difficult to establish.

Hazard Hill (N/SX1) and High Peak (N/SY1) only have single dates, but they are similar, or possibly a little later than those from Hembury and Maiden Castle.

4920 \pm 150 BP (2970 bc) BM-149 Hazard Hill

4810 \pm 150 BP (2860 bc) BM-214 High Peak

The remaining sites are two unenclosed settlement sites and a long barrow. Poldowrian (N/SW2), Cornwall, the only dated Neolithic site from the far south-west apart from Carn Brea, has two dates from pits, one of which contained Neolithic pottery.

5180 \pm 150 BP (3230 bc) HAR-4323

4870 \pm 130 BP (2920 bc) HAR-4052

These were related to various other features, including a paved area and traces of a tent-like structure. However, these dates only overlap at two standard deviations, and

may represents different occupation phases. Though there were no obviously Mesolithic features on the site, earlier occupation was evidenced by the numerous microliths and other diagnostically Mesolithic artefacts. A mid fourth millennium bc date was produced from a sample of hazelnuts shells:-

5450±110 BP (4500 bc) HAR-4568

Four dates come from the same postpit at Rowden (N/SY3), Dorset. The earliest seems anomalous, though it does overlap with the others at two standard deviations, and was probably on old timber:-

5250±140 BP (3300 bc) HAR-52462

The average of the other three places them too late for inclusion in this study, and this feature is probably the result of later activity.

The date from Thickthorn Down long barrow (N/ST6), Dorset, appears to be rather early compared to other barrows also built using "bays" or "hurdles" e.g. South Street and Beckhampton Road (Smith and Evans 1968).

5160±45 BP (3210 bc) BM-2355 Thickthorn Down

4700±130 BP (2750 bc) BM-357 South Street

4362±90 BP (2412 bc) BM-506a/b Beckhampton Road

There was some possibility of contamination by preservative, but every effort was made to remove this, and Bradley and Entwistle (1986) advise that the date should not be rejected out-right. The monument type is not well enough dated to be sure that their construction did not occur as early as this.

Late Mesolithic dates have come from Blashenwell (M/SY1), on the Dorset coast, the latest of which suggests Mesolithic occupation into the last half of the fourth millennium bc.

5750±140 BP (3800 bc) BM-1257

5425±150 BP (3475 bc) BM-1258

However, their relation to a specific archaeological layer is very insecure. Preece (1980) did not find enough datable material during his excavation, and so used bones from a museum collection. He tried to locate them stratigraphically using snail assemblages

associated with the bones, but despite concluding from these that the two bones were from similar layers the dates are quite different. However, the bones did come from archaeological layers and artefacts throughout the midden appear to have been Mesolithic.

A fourth millennium bc date from Windmill Farm (M/SW1), on the Lizard peninsula, was associated with late Mesolithic material, and provides some support for the latest Blashenwell date:-

5470±130 BP (3520 bc) HAR-5668

In contrast to these early fourth millennium bc dates the very late survival of Mesolithic culture into the late Neolithic has been claimed at Three Holes (O/SX1), Devon. This site has a date of:-

4450± BP (2500 bc) I-549

from layers containing late Mesolithic artefacts. The possibility of the survival of Mesolithic traditions cannot be completely ruled out, but the excavator (Rosenfeld 1964) argues convincingly that the Neolithic artefacts present in predominantly Mesolithic layers probably travelled down from above, due to bioturbation and other natural processes. Despite this she ignores her own arguments, and does not consider the possibility that the dated charcoal also originated in higher levels. The stratigraphy is clearly too uncertain on this site for any contentious claims to be made on its evidence.

For this area therefore we have very tentative evidence of Mesolithic activity into the late fourth millennium bc. Neolithic activity may have started in the second half of the fourth millennium, but it is only firmly dated from 3147-3067 bc (3963-3785 cal.BC).

3.3.3.2 Ireland

It is not intended to discuss Ireland in detail throughout this thesis, but it must be mentioned in reference to radiocarbon dates, because of the impact certain Irish dates have had on the dating of the beginnings of agriculture in the British Isles as a whole. However, the dating evidence is poorer even than that from mainland Britain, and conclusions must, as yet, be tentative. Dating activity, like much of Irish prehistoric research, has been concentrated in the north of the island (Edwards 1985). However, there is considerable evidence that most of Ireland was occupied in both the Mesolithic and the Neolithic (Woodman 1985), so the present set of dates can offer information about only a small part of this area.

An overview of the archaeological dates reveals some broad trends (figure 3.15a and b). In general the Mesolithic dates do not extend after 3000 bc, even at two standard deviations. The Neolithic dates do seem to be very early compared to Britain, but the earliest dates are from only two sites, Carrowmore and Ballynagilly, which will be discussed in detail below. Dates from most other sites fall after 3500 bc.

Mesolithic dates

The latest Mesolithic dates from Ireland fall into a neat group, which suggests late Mesolithic activity continuing after 3500 bc. There is no clear geographical difference, the later phases at Newferry being dated the same as the east coast midden sites. Ferriter's Cove (M/V1), Co. Kerry, is particularly interesting as this is one of the very few early sites excavated, and dated, in the south of Ireland. Each of the three dates are from small, discrete midden sites in the Cove.

5804±95 BP (3854 bc) BM-2228R/AR Site 2

5496±101 BP (3546 bc) BM-2229R/AR Site 3

5414±124 BP (3464 bc) BM-2227R/AR Site 1

The dates suffered from the British Museum laboratory's systematic errors (Bowman *et al* 1990), so despite being the product of combining repeat dates, the corrected dates have fairly large errors. The dates are on charcoal, which can be fairly mobile in shell middens, so the dates might be considered to be a rough average of activity occurring on the sites. The latest date is from site 1, and may represent Neolithic activity. Most of the assemblages are somewhat atypical of sites further north, but some forms, such as Bann flakes and picks, are typical of the late Mesolithic of Northern Ireland (Woodman 1992 p302). Site 1, however was slightly different to the others, and a planoconvex knife appears to have come from the same midden. There was no evidence of pottery or domestic animal bones on any of these sites, despite preservation of bone. Woodman *et al* (1985) have therefore concluded that all three "*straddle the Mesolithic/Neolithic change*" (p3).

At Newferry site 3 (M/H3), Co. Antrim, fairly late dates were produced from area 3:-

5705±90 BP (3755 bc) UB-630

5415±90 BP (3465 bc) UB-489

which also produced two "Neolithic-type" cores and a single sherd of pottery, as well as a typically Mesolithic industry (Woodman 1977). However, Woodman (1978b) warns against placing too much weight on individual dates because of the large quantity of charcoal on the site, and the possibilities of mixing. The Neolithic elements may also have come from the level above, which produced over 100 sherds (Woodman 1977).

The latest date is from site 4:-

5290 \pm BP (3340 bc) D-36

and is far from reliable, not only because it is a single date measured many years ago, but also the occupation layer the sample came from was disturbed (Woodman 1978b).

Ringneill Quay (M/J3), Co. Down has two dates from a midden layer overlying the post-glacial maximum marine transgression beach.

5380 \pm 120 BP (3430 bc) Q-770

3680 \pm 120 BP (1730 bc) Q-633

Both dates are from the same layer, but while Q-770 fits well with the other Irish Mesolithic dates, Q-633 is much later, and probably anomalous. The bone of a small ox was found in this layer, and as there is no evidence for wild cattle in Ireland this was presumably domesticated. The artefacts were undiagnostic and could not be assigned to a particular culture, leaving open the possibility that the midden was Neolithic. There were no blades and only one typically Larnian leaf-shaped flake. So it is hard to be sure if this was a Mesolithic group who had obtained domestic cattle, or a Neolithic group exploiting marine resources. This very blurred boundary is typical of the Transition in Ireland, in contrast to Britain where distinctions normally appear rather clearer.

The date from Rockmarshall (M/J4), Co. Louth:-

5470 \pm 100 BP (3520 bc) I-5323

while being a single date on charcoal, and therefore possibly subject to inaccuracy of measurement and insecure origins, does compare very well with the dates from other sites. Its relationship to the maximum sea transgression is also suggestive that the date is correct. It is located above the highest sea level, and was probably occupied during the period of maximum sea transgression, which is dated to the mid fourth millennium bc elsewhere in Ireland (Woodman 1978b).

Sutton midden (M/N3), Co. Dublin, has another similar single date:-

5250 \pm 110 BP (3300 bc) I-5067

and was occupied just before the post-glacial marine transgression reached its maximum. The industry on this site was firmly Larnian yet the one piece of bone found was from a domestic ox. There is no Neolithic presence on the midden, the nearest known Neolithic site being 6 miles away. A backed knife and polished stone axe from Sutton midden, originally thought to be Neolithic, were later accepted as Mesolithic. This site is therefore more convincing than Ringneill Quay as representing the presence of a Mesolithic group, which has acquired cattle or at least beef.

Dalkey Island (M/O1), close to Sutton, has several midden sites. One produced a mid fourth millennium bc date:-

5300 \pm 170 BP (3350 bc) D-38 site V

This site does have Neolithic occupation on top of the Mesolithic midden, though the dated sample and Mesolithic artefacts came from fairly well stratified and undisturbed shell layers. This would not necessarily preclude some movement of charcoal down through the midden. A second date came from a burial in another nearby midden, site II:-

4160 \pm 150 BP (2210 bc) BM-78

This midden had pottery and other Neolithic artefacts in the upper layers, and both the burial and upper layers of the midden are probably late Neolithic. This demonstrates a continuity of activity on the same sites across the Transition, reminiscent of Inveravon midden on the Forth Estuary.

One inland site has also produced a fairly late fourth millennium bc date; a site on Lough Derravaragh (M/N2), Co. Westmeath:-

5360 \pm 110 BP (3410 bc) I-4234

The site is interpreted as a short term location from which birds and fish were hunted in the surrounding marshes (Mitchell 1972b). As a single date on charcoal, this is not a very reliable date, and unlike the coastal sites, does not have the sea level evidence to support it.

Dates from the above sites seem remarkably similar, and though the individual dates are far from secure, they may provide some support for each other. The present

evidence would seem to suggest the continuation of a recognisably Mesolithic tradition in Ireland after 3500 bc, and possibly as late as 3250 bc. New excavations and dates on the midden sites, as well as increased searches for late Mesolithic sites elsewhere in Ireland would allow much more confident statements to be made about the end of the Irish Mesolithic.

Neolithic dates

Unlike mainland Britain Neolithic dated sites do not outnumber the Mesolithic ones by very many. Most sites have only one or two dates, though many are closely associated with specific activities. A wooden structure below the megalithic tomb of Dooley's Cairn, Co. Antrim, has produced two fairly close dates²⁰, as has Poulmabrone, Co. Clare:-

5150±90 BP (3200 bc) UB-2030 Dooley's Cairn

4940±50 BP (2990 bc) UB-2029 Dooley's Cairn²¹

5100±80 BP (3150 bc) OxA-1906 Poulmabrone

4940±80 BP (2990 bc) OxA-1910 Poulmabrone

The latter is a portal tomb, which was probably used over some 600 years, with the earliest burials dated to end of the fourth millennium bc. Both dates are on human bone from the main chamber, so the dates are closely related to the use of the tomb.

Mad Man's Window (N/D1), Co. Antrim, has produced a date from a hearth associated with a typically Neolithic assemblage:-

5095±120 BP (3145 bc) UB-205

Unfortunately it is a single date, and the site has not been published.

20. See footnote 18 p71.

21. Woodman (1992) gives error of ±150 for this date

Two similar dates came from the old land surface under the court cairn at Carnanbane (N/H2), Co. Londonderry.

5045±95 BP (3095 bc) UB-535

4930±80 BP (2980 bc) UB-534

The dated samples were associated with western Neolithic pottery, but charcoal in an old land surface is of insecure origin.

Knockiveagh hilltop cairn (N/J2), Co. Down has produced a similar date from a pre-cairn context:-

5020±170 BP (3070 bc) D-37

Five radiocarbon dates come from house 1 at Tankardstown, Co. Limerick; three on oak planking from the foundation trench and two on charred grain from an internal post-hole and the foundation trench. These dates lie between 5105±45 and 4840±80 BP (Gowen and Tarbett 1988)²². Full details of the dates do not yet seem to have been published, but it might be expected that the earliest date is on charcoal, and subject to the old wood effect. It is probable that the true date for the feature makes it a little too late to be included in this study, though it would be useful to know where the dates on the grain fell in the range.

The court tomb at Ballymacdermot (N/J1), Co. Armagh, is probably later than the previous sites as the earliest secure date is:-

4830±95 BP (bc) UB-694

There is a much earlier date from between the lowest cairn stones:-

6925±95 BP (4975 bc) UB-702

but this is probably charcoal from earlier activity that has accidentally become incorporated in the cairn, and should be discounted.

22. Due to the scarcity of information on these dates this site is not included in appendix II.

There is also a very early date from one of the small passage graves at Knowth (N/N1), Meath:-

6835±110 BP (4885 bc) UB-358

but this is on humic acid from a sod layer in the mound, and shows nothing more than the persistence of humus in the soil. The other dates from this site are centred in the early third millennium bc, though their large errors make them extend into the end of the fourth millennium bc.

On the basis of the evidence discussed above, the dates from Neolithic contexts in Ireland fall significantly after 3500 bc, even at two standard deviations. Only two sites disrupt this pattern, and the frequency with which they are quoted as evidence for a very early Irish Neolithic makes them particularly important.

Carrowmore

(Figure 3.16)

The Carrowmore megalithic cemetery (N/G1), Co. Mayo, is a large and important site, but certain highly controversial claims have been made for it. Many of the tombs are rather simple in design compared to other Neolithic tombs, and its low-lying, unobtrusive location is not typical either, though there are good views from the site (Kitchen 1983). Burenhult (1984) has used its atypicality to argue that the earliest megaliths in the cemetery are Mesolithic. Woodman (1985) considers this argument to be based on only negative evidence. The tombs have produced little Neolithic material, which Burenhult claims it is because they are Mesolithic. However, there is "*not a single Mesolithic-type artefact from the tombs*" (Caulfield 1983 p206), and many Neolithic tombs elsewhere contain few artefacts. Burenhult also uses the presence of marine shells to argue that the cemetery builders had a traditional hunter-gatherer economy, though shellfish are exploited throughout Irish prehistory and into historic periods (Aalen 1978).

Central to the Mesolithic megaliths argument are the radiocarbon dates. Caulfield (1983) finds the earliest dates unconvincing. Out of 17 dates from the tombs 6 were earlier than 2300 bc. One from grave 7 is from a posthole under the hard packed floor of the chamber:-

5240±80 BP (3290 bc) Lu-1441

This feature was located in the centre of the boulder circle of the grave, and may be associated with its construction. However, there were other postholes and shell deposits

under and outside the grave area, which could represent earlier activity on the site. Grave 27 has three very similar late fourth millennium bc dates from a charcoal spread related to the construction of the cairn.

5040±60 BP (3090 bc) Lu-1698

5000±65 BP (3050 bc) Lu-1808

4940±85 BP (2990 bc) Lu-1810

This makes it a fairly reliable date, suggesting that at least some of the tombs were constructed in the late fourth millennium bc. The one date on which the controversy is based is from grave 4. On excavation this appeared to be later than grave 7, which was confirmed by a third millennium bc date, from grave 4, however an early fourth millennium bc date was also produced.

5750±85 BP (3800 bc) Lu-1840

This came from the stone foundation of the central cyst in close association with a date of 260±55 ad. Caulfield (1983) suggests that this is unreliable, possibly the result of disturbance in the cairn.

The other early dates from this site are not directly related to the tombs.

6250±100 BP (4300 bc) OxA-701

6170±90 BP (4220 bc) OxA-702

5960±90 BP (4010 bc) OxA-703

5410±50 BP (3460 bc) Q-2601

All except Q-2601, which is on charcoal, are on terrestrial shells. These are particularly unreliable as dating materials, and often contain old carbon from the ground water, as discussed above. The reliable dates from Carrowmore, therefore, fit well with the other Irish Neolithic dates, and do not extend significantly before 3500 bc. A very early date for activity at Carrowmore "*remains questionable*" (Kinnes 1988 p6), and there seems to be little justification for claiming very early Neolithic-type activity on the site, or the construction of monumental tombs by Mesolithic groups.

Ballynagilly

Though other particularly early dates for the Neolithic might be rejected the site of Ballynagilly (N/H1), Co. Tyrone, remains as the single archaeological example of Neolithic culture in Ireland before 3500 bc. The Neolithic features are scattered over a hilltop. The main feature is a Neolithic house solidly constructed of vertical oak planks, supported by corner posts. This produced leaf-shaped arrowheads, Lyles Hill ware and radiocarbon dates of:-

5370±85 BP (bc) UB-304 pit

5290±50 BP (3340 bc) UB-551 hearth

5230±125 BP (3280 bc) UB-199 house post hole

5165±50 BP (3215 bc) UB-201 wall planking

4910±90 BP (bc) UB-301 pit

4835±55 BP (bc) UB-625 pit

These are probably rather too old because they are from mature oak timbers. ApSimon (1976) suggests an extra error of -120 to -200 years. These, therefore, fall within the range of Neolithic dates from Britain and Ireland.

There was an earlier Neolithic phase on the site, which included a hearth associated with posts, stakeholes and Lyles Hill pottery, and two pits containing the same ware. The largest of these had *in situ* burning and Neolithic-type flint artefacts. All these produced charcoal which was dated.

5745±90 BP (3795 bc) UB-305 Hearth

5640±90 BP (3690 bc) UB-307 Pit

5625±50 BP (3675 bc) UB-197 Large pit

5500±85 BP (3550 bc) UB-559 Pit

A much later date from the occupation area associated with the hearth is probably anomalous.

4880±110 BP (2930 bc) U-306

In this early phase there were no leaf-shaped arrowheads, querns or cereal grains, either charred or as impressions in pottery. There were large numbers of burnt hazelnut shells, but no typical Mesolithic artefacts. The lithics are of a normal Neolithic type and pottery was present. ApSimon (1976) discusses possible causes of these early dates, but concludes that there is no reason to see them as anomalous. Old wood may have been used, but the earliest dates are nearly 500 years earlier than those on the house, and this does not seem sufficient to explain the difference. The use of bog oak is precluded because there was no blanket bog in the area at the time. The charcoal samples were closely associated with the artefacts and the contexts well sealed. The lack of Mesolithic artefacts suggests there was no occupation from that period on the site, and the lack of microcharcoal in the nearby contemporary valley bog deposits suggests no general burning episode at this time. While it is hard to criticise the Ballynagilly dates, they remain unsupported by any other archaeological dates from Britain or Ireland (Kinnes 1988, Thomas 1988). The presence of possible cereal-type pollen grains at an interpolated date of 3800bc, in the bog next to the archaeological site, does provide tentative support of the early date for the Neolithic here (Pilcher and Smith 1979). However, Kinnes (1988) is doubtful of the dates because they imply that early Neolithic pottery remained unchanged for a millennium in Ireland, which Kinnes considers "*unparalleled and surprising*" (1988 p6). The early dates from Ballynagilly, therefore, cannot be disregarded as easily as those from Carrowmore, and must stand, with some reservations, as a genuine exception until more radiocarbon dating has been carried out in Ireland.

3.3.3.3 Discussion

The date of the Transition

Bradley (1984a) has claimed that there is "*a gap of some 700 years between the radiocarbon dates for the late Mesolithic, and those for nearly all early Neolithic artefacts and monuments*" in Great Britain (p8). Yet this gap is not evident in the present data base. This is largely due to the dates being plotted at two standard deviations. Unfortunately, while this is less precise, the use of one standard deviation is statistically incorrect, and gives an erroneous impression of the precision of radiocarbon dating. If the dates were plotted at one standard deviation a gap would be revealed, though

this is no more than about 200 years, and probably less in southern England. However, the true dates are almost as likely to fall outside this range as within it, so one standard deviation cannot be used to imply the most probable range of a group of radiocarbon dates. This is a limitation inherent in radiocarbon dating, and can only be corrected by technological advances, not by wishful thinking. Whittle (1988) makes the point very clearly that radiocarbon dating is "*a very blunt chronological weapon*" (p22) and that its inevitable lack of precision cannot, at present, be over emphasised.

Despite the number of dates collected in the catalogue Kinnes's statement that "*the radiocarbon framework that exists is inadequate and often misleading*" (1988 p6) must still stand, especially in relation to the late Mesolithic dates. Conclusions, therefore, must be very general, and apply only to those sites attributable to a recognisable culture. The earliest Neolithic dates fall between 3500 and 3000 bc, with no statistically significant variation across the country. Figure 3.17 demonstrates how similar the averages of dates from all regions are. Calibrating these averages only reduces the differences between the regions. These graphs can only be a very rough indication of the trends of the dates, but they do suggest that recognisably Neolithic traits spread so rapidly that no single region can be identified as the originator of those traits. The Mesolithic dates rarely extend after 3500 bc, though not all those that do can be rejected.

Mesolithic survival

Existing radiocarbon dates are too few to provide support either for or against the late survival of a recognisably Mesolithic culture. Very late dates on Mesolithic assemblages, e.g. from Three Holes and Loch Doon, seem to be anomalous. There is at present little evidence for the survival of a recognisably Mesolithic technology beyond the end of the fourth millennium bc. However, this may have been possible in isolated upland areas and on the west coast of Scotland, where a stable, well adapted economy had developed. In general most dates for Mesolithic sites do not extend much after 3500 bc, and seem to merge neatly with the Neolithic dates with a minimum of overlap, though this could be due entirely to insufficient late Mesolithic dates. The only significant exceptions to this are the dates from Carding Mill Bay, which imply the survival of a typically Obanian cultural assemblage into the third millennium bc. In Ireland there are more late Mesolithic dates, again mainly from shell middens. These are probably the most visible of late Mesolithic sites, and often contain datable material. Late dates from shell middens may, therefore, represent the most easily recognised aspect of a widespread Mesolithic tradition towards the end of the fourth millennium bc. Alternatively, the specific economic conditions of this type of coastal economy may have ensured the late survival of Mesolithic traits in certain areas. Unfortunately, the loose consistency of shell middens suggests a

third interpretation of the dating evidence. Perhaps downwards movement of charcoal and shells is a common feature of shell middens, and most dates merely represent contamination by later material.

Clearly a programme of dating late Mesolithic sites is necessary to clarify the questions raised by the existing data base, but the slight and poorly stratified nature of the sites poses problems. What is most needed are dates firmly related to diagnostic Mesolithic activity, preferably achieved by dating artefacts directly. As many Mesolithic sites have poor conditions for bone preservation this is often not possible, but well stratified dates on other materials would enable some progress to be made. Bone, or even better, bone tools preserved in the alkaline conditions of shell middens might prove most successful, if searched for and dated as part of a planned programme. The greatest problem in devising a programme to identify transitional sites is that, by their nature, these sites are likely to lack clearly diagnostic artefacts. Extensive dating and lithic studies would seem to be necessary before genuinely transitional sites could be identified, and placed in their chronological context.

Earliest agriculture

While in some areas the Neolithic dating evidence is also poor, the earliest dates for this culture are remarkably consistent, despite the geographic differences, and a variety of site types. Wales, central and eastern England have dates as late as northern Scotland. The secure dates from south-west England are fairly late, and any indication of an early presence is given only by dates with large errors. Ireland is intriguing because of the early dates from Ballynagilly. The dates from this site are unsupported from any other archaeological site in Ireland or Great Britain, but so few early Neolithic sites have been dated in Ireland that the discovery of other early seems probable. The majority of Irish early Neolithic dates are on tombs, which if related to a consolidation phase might suggest a date of at least 5500 BP for the start of the Neolithic (Woodman 1992).

The south-east of England has for some time been suggested as a focus for cultural and economic change, because of the early dates on sites with well developed Neolithic traits. However, it must not be assumed that the start of the Neolithic period in this region is well dated. The errors on most of the dates are very large, many were produced some time ago, and most importantly, the majority are single dates. If the period was well dated these dates could be justifiably discarded as Kinnes *et al* (1982) suggest, only the poor nature of the dating evidence forces their use.

Harrow Hill graphically demonstrates the problem (figure 3.12). Despite the fact that its 6 dates probably originate from the same, short phase of activity, they cover a time span as long as that for the all the fourth millennium Neolithic dates. Any of the earliest dates from this region could have a true date little earlier than Harrow Hill's average date of 3097 ± 51 bc. Bowman and Balaam (1990) advise that future funds for radiocarbon dating could be better spent if poorly dated periods are concentrated on. This is sensible advice, but adequate dating must be judged, not by the number of dated sites, but by the quality of those dates. In many ways south-east England has as much need of new early Neolithic dates as Scotland. The possibility remains that more accurate and precise dates will not support a very early appearance of the Neolithic in this region.

Thomas (1988) claims that "*it is increasingly difficult to sustain a case for a mid-fourth millennium (bc) Neolithic presence in Britain*" (p61), and certainly the archaeological radiocarbon dates support this statement. Archaeological evidence, as dated by the radiocarbon technique, for a Neolithic presence in Great Britain before 3500 bc is non-existent, and the majority of the dates suggest the fully formed culture did not appear until the last quarter of the fourth millennium bc. When it did appear it did so almost simultaneously across the country, south-east England perhaps having a slight head start.

This is a fairly traditional statement, though it has not been so well supported before. The traditional objection to this is the argument that "pioneer settlements" were "archaeologically invisible". It might be expected that within 35 unenclosed settlements, including many slight remains found by chance during the excavation of later features, that a small number of these pioneer settlements would be revealed. This was not so, and their existence remains completely theoretical. At present the dates provide support for those writers who suggest that monumental tombs were "*not optional extras, but were a constituent element of the Neolithic package, as much so as crops or livestock*" (Thomas 1988 p64). Only the site of Ballynagilly in Ireland suggests that further research might reveal earlier dates, and continues to instil doubt into any over confident statements about the date of the beginnings of agriculture in the British Isles.

CHAPTER 4: PALAEOENVIRONMENTAL EVIDENCE

4.1 Introduction

See appendix III for details on the dated diagrams discussed in this chapter, and figure 4.1 for their location.

Agriculture represents a different type of landuse to hunter-gathering, and as such might be expected to leave different traces in the palaeoenvironmental record. As with dating techniques, archaeologists rely on specialists to furnish data, but in this case the specialists are more heavily relied on to interpret that data. Without considerable inter-disciplinary discussion there is the potential for confusion, and the unquestioning, cross-disciplinary borrowing of theories. There is a danger in these circumstances that fallacies, and inadequately tested ideas will become entrenched in the literature, and accepted as fact.

The use of palaeoenvironmental evidence is important in the study of the Transition, as it helps correct some biases in the archaeological data. It can provide radiocarbon dates for agriculture-related events from areas with few dated archaeological sites, and covers the early fourth millennium bc, from which there is little archaeological data. Pollen sites, especially, are concentrated in upland areas and northern Britain, where dated sites are rare. It may also be a more sensitive indicator of the presence of agriculture, as archaeology can only recognise cultural change, which may occur significantly after the introduction of agriculture itself.

4.1.1 Pros and cons

Palynology forms the majority of the environmental evidence, as more work has been done on the archaeological applications of this discipline than other palaeoenvironmental techniques. The study of mollusc species is important in areas with alkali soils, which inhibit pollen preservation (Thomas 1982). Less frequently a variety of other techniques are also studied as environmental indicators, for example colluvium formation (Bell 1983), insect assemblages (Buckland 1976), diatoms, and the chemical composition of lake sediments (Pennington *et al* 1972). Each technique has its faults and advantages, many of these are complementary, and interpretations can be most confident when several methods are used together (Dimbleby 1975).

4.1.1.1 Palynology

Edwards (1979) is enthusiastic about the ability of pollen analysis, supported by radiocarbon dates, to "*provide a staggering amount of environmental information*" (p27). While this may be true, the problems of interpretation cannot be overlooked. Few palynological conclusions are straight-forward, and a variety of interpretations are often possible. Archaeologists need to recognise the strengths and limitations of palynological data, so that theories are not based on evidence that cannot support them.

The range of problems and biases varies with the type and size of sampling site. Large lakes preserve a regional pollen record, but can contain old, reworked pollen grains, whereas smaller lake sites and peat bogs collect pollen of fairly local origin, as is demonstrated by the degree of diversity in neighbouring diagrams (Pennington 1965, Whittington *et al* 1990, 1991). The representation of a species in the pollen record depends on the ability of that species to produce, and disperse, its pollen. Wind-pollinated species tend to produce large quantities of pollen that is released into the air, and may travel considerable distances. They are often over represented because of the large quantities of pollen produced (Edwards 1982). Insect or self-pollinated species produce less pollen, and do not disperse it widely. These tend to be under represented in pollen spectra, especially if they do not grow near the wet areas where pollen is preserved (Rackham 1988). Changes in direction of prevailing wind, or the location of streams could result in pollen from different habitats reaching a site, even though no vegetational change occurred (Annable 1987).

Pollen diagrams are statistical representations of the raw data, and as such the methods used to compile them may actually cause artificial features (Annable 1987). In percentage diagrams, which until recently were most commonly used, the proportions of different taxa were interrelated, making it impossible to identify whether the increase in one species was real, or a function of the decline in another species. Use of 'absolute' diagrams can resolve these problems, as each taxa is independently represented, and changes masked by the percentage diagram can be revealed. 'Absolute' diagrams are compiled by calculating the concentration of pollen per unit volume, or weight, of sediment. If the profile is dated the influx of pollen per unit area can be estimated (Pennington 1975, 1979). Enough dates are rarely taken to actually calculate the accumulation rate, so this may vary to unknown degrees, severely distorting the diagram. 'Absolute' diagrams based on a small number of dates give only a false impression of accuracy, and may actually be misleading (Shore 1988). General changes in pollen influx are detected by absolute diagrams, which can be useful in detecting farming activity as

these can indicate soil erosion in the catchment area (Pennington 1979, Hiron and Edwards 1990).

The sampling interval and the number of grains counted per level influence what can be seen in a diagram (Annable 1987), details of minor or short-lived clearance episodes being visible only at fine resolution. The use of different pollen sums makes comparisons between diagrams difficult, especially where only extracts of diagrams are published, hindering regional vegetation studies (Caseldine and Maguire 1981). Large counts per level of around 1000 grains even out random variation between samples, and allows the inclusion of rare herbaceous pollen that may occur as only one grain per 1000. In practice counts are usually much less than this because they are so time consuming (Pennington 1979).

Some pollen taxa important in the study of prehistoric economic activity cannot easily be identified to species level. This will be mentioned below in reference to cereals and elms, but is also important in relation to hazel, which has possible economic significance in prehistoric Britain. Coryloid pollen is usually assumed to represent hazel, but it is not possible to distinguish this species from bog myrtle (*Myrica gale*), with a light microscope (Edwards and Ralston 1984). *M. gale* has a very different ecology, and as it grows in bogs may make a significant contribution to the pollen record (McIntosh 1986). Increases in Coryloid pollen, in some cases, could indicate, not an expansion of hazel trees, but of moorland or bog (Carter 1986).

Palynological evidence tends to be concentrated in highland areas where soil conditions are best for pollen preservation. However, these locations are generally distant from known archaeological sites, making it hard to correlate archaeology and environmental evidence. It also means that the palaeoenvironment of the lowlands is less thoroughly studied, because of the scarcity of suitable deposits (Annable 1987). Even in areas, such as south-west England, where there are peat deposits, the absence of natural lakes deprives palynologists of the more regional information that can be gained from these sites (Caseldine 1983). Perhaps because of the scarcity of suitable bogs and lakes in southern England, there has been a much greater emphasis on obtaining pollen evidence from deposits on archaeological sites.

Pollen can be present in buried soils and floodplain sediments even in chalklands, however, pollen in mineral soils suffers decay and mixing to a much greater degree than in peat (RW Smith 1984). Cundill (1989) considered that there was little worthwhile data to be gained from pollen analysis on mineral soils because of the degree to which soil fauna move pollen through the profile. Other researchers are more enthusiastic, the quality of

the results being dependant on the existence of a good, sealed context on the site. Mineral soils tend to represent localised vegetation, and may indicate clearances, or other events, not represented in the more regional diagrams of peat or lake sites (Dimbleby 1975, 1976a).

The type of information to be gleaned from pollen in mineral soils depends largely on the pH value of the soil. In acid soils pollen may be preserved for thousands of years, and a broad sequence of vegetational history may be preserved. In basic soils pollen is rapidly destroyed, and only preserved if sealed under a feature, such as a barrow. Basic soils cannot show changes in vegetation, but provide a single spectrum representing the vegetation type just before the occurrence of a specific archaeological event. The degree of mixing, differential preservation, and other problems make interpretation of pollen in mineral soils more problematic than in other deposits (Dimbleby 1975, 1976a).

The problems of dating peat have briefly been mentioned above, but before the dates collected in this chapter can be discussed it is worthwhile summarising an important study on this subject. By radiocarbon dating 1cm thick, contiguous samples of two neighbouring peat monoliths Shore (1988) identified variations in peat accumulation, including date reversals from reworked sediment, and hiatuses in accumulation, that would be undetected by coarser dating. When slices of peat 4-5cm thick are used for dating a core, as is usual, actual accumulation rates are almost impossible to determine. Shore dated three peat fractions for most samples: humic acid, humin, and fulvic acid. In one monolith humic acid was consistently older than the other fractions, but in the other monolith humin was generally older. This suggests that humic acid can move, both up and down, more freely than is often assumed, and there is no easy rule to determine which fraction provides the most reliable date. It seems to be important to date both humic and humin fractions, and note their relative contributions to a combined date. Fulvic acid makes too small a contribution to the sediment to be significant. The processes of peat formation are poorly understood, and any claims based on them must be considered spurious. The errors and pitfalls of radiocarbon dating pollen profiles are not adequately discussed at present, and all dated diagrams should be treated with caution.

I have encountered a communication problem between palynologists and archaeologists in relation to radiocarbon dates, which may explain the rather overly exact use of dates on pollen events in relation to archaeological events. This seems largely to arise from working with different time scales. On a scale of the whole Quaternary period radiocarbon dates, even of peat, are sufficiently precise, however, when attempting to determine the chronology of events within the fourth millennium bc they are no more than

very general indicators. This statement, as discussed in chapter 3, applies to dates quite closely related to archaeological activity. When peat is dated the origin of the organic material may be even less well established, and the date is usually an average of the age of a fairly thick slice of peat. If a radiocarbon date at 2 standard deviations covers a time span of 400 years, as is common, and that date is on a slice of peat that may cover several hundred years, it seems difficult to use this as evidence that an event occurred at 3800 bc rather than 3400 bc. Palynology normally deals with natural vegetational change, and demonstrating such minor temporal differences would not seem of much relevance, but this is exactly how archaeologists, and palynologists interested in the beginnings of agriculture, sometimes use dates on pollen diagrams (e.g. discussions on the synchronicity of the elm decline; Groenman-van Waateringe 1983, Huntley and Birks 1983, Smith and Pilcher 1973).

4.1.1.2 Other techniques

Of the many other environmental techniques relatively few have been used to investigate the Transition in Great Britain. Plant macrofossils are particularly important for indicating which species are present on an archaeological site, though they can also indicate the presence in the environment of a species not represented in pollen diagrams. This is useful in demonstrating the presence of shrub species, e.g. hawthorn, by the preservation of their wood or charcoal. These may indicate the presence of secondary woodland. Wood collection by humans is highly selective, so a full range of tree species is unlikely to be represented in the charcoal of an occupation site (Dimbleby 1975). Timber from the Sweet Track, Somerset Levels, provided evidence for a clearance episode at about 3950 ABC. Oaks used at the south end of the track were much younger than those at the north indicating the existence of secondary woodland in that area. Despite environmental work on the Levels there is no other evidence for this clearance episode (Hillam *et al* 1990).

More commonly macroscopic plant remains are used to identify economically important plants. As most macroscopic plant remains survive due to carbonisation, the types of species represented are biased by the likelihood of this occurring. Only when a site has been destroyed by a general conflagration, is a wide range of species likely to be preserved by charring (Dennell 1977).

Assemblages of land molluscs are used to provide environmental information in calcareous areas, where there is little potential for pollen preservation. Snail shells preserve well in calcareous soils, and do not suffer too badly from mixing by earthworms,

as they are generally too large for the worms to ingest. However, the information they reveal is very localised, and they do not respond as rapidly as pollen to changes in the vegetation (RW Smith 1984). Woodland molluscs are not easy to define as some species can be limited in their distribution by temperature, not moisture, and may be found in exposed places. Those limited by moisture may be found in damp environments outside woodlands, especially in ditches, making mollusc evidence from these potentially extremely localised. It is important to draw conclusions from the whole assemblage, rather than isolated species. Mollusc sample sizes are often relatively small, and there is a danger that they will not be representative of the whole population (Thomas 1982).

Insects are probably better environmental indicators. They have colonised every available habitat, are specific to certain habitats, and have a chitinous cuticle which is quite resistant to decay. They are often better than pollen for recording minor climatic fluctuations (Dennell 1977), and can provide detailed information on microhabitats e.g agricultural type, or the use of buildings (Dimbleby 1975). Communities of insects can indicate the climate and vegetation type at both local and regional levels, and reveal the presence of plant species not represented in the pollen record (Buckland 1976). Beetles provide sensitive indicators of woodland disturbance, but few studies of beetles have been carried out on Mesolithic sites (Girling 1982). In reference to early agriculture beetle communities can indicate pastureland: some species are specific to grassland habitats, and dung beetles represent grazing by herbivores (Osborne 1978). The grain weevil could be a useful indicator of grain storage, but while it may have been introduced to Britain in Neolithic seed corn, unfortunately no actual specimens have been found before the Roman period (Buckland 1976).

Chemical and magnetic studies of lake sediments can be used to detect erosion. Minerals such as sodium and potassium normally enter a lake in solution, and drain out with the water. If erosion occurs sediment is deposited too quickly for these minerals to dissolve, and they are deposited still locked in the mineral particles of the soil (Mackereth 1965). Erosion also removes ferrimagnetic minerals, and washes them into the lake, increasing the magnetic susceptibility of the sediments in lakes with oxidising conditions (Edwards 1979a, Mackereth 1965). An increase in halogens in lake sediments can indicate an increase in rainfall, though they are also related to leaching (Mackereth 1965). The problems of interpreting these types of data is demonstrated by the lack of agreement often seen between clearance in the pollen record and indicators of erosion (Edwards 1979b). More work is necessary on these methods before firm conclusions can be drawn on what exactly these changes represent.

4.2 Forest Clearances

4.2.1 Atlantic period clearances

The Atlantic period saw the maximum development of deciduous forest in Europe. This forest is traditionally seen as "*rather monotonous 'mixed oak forest'*" (Rackham 1986 p68), but study of surviving ancient forest remnants, and a reassessment of the pollen record make "*the notion of a single climax tree community...untenable*" (Rackham 1988 p4). Lime and ash are greatly under represented in pollen diagrams, because they are low pollen producers, and alder is probably over represented because it grows in wet places, close to the deposits sampled for pollen analysis. Although surviving ancient woodland is restricted to the poorest soils, it can suggest the probable variety of the wildwood. Some tree species are naturally gregarious, and grow in stands, while others are randomly distributed, or anti-gregarious, occurring singly. Even the dense lime forests of southern England are likely to have had a patchwork of other trees, and did not necessarily discourage human settlement (Jacobi 1978). However, there is no evidence that chalk geology supported lighter forest than the clay, as is often claimed by archaeologists (Rackham 1988). Comparisons with North American ancient woodland can give further indications of forest structure, though comparisons must be made with caution as the ecology of American forests is somewhat different to those of Britain (Rackham 1986, 1988).

Few native shrubs grow well in shade so the Holocene wildwood might be expected to have a low available biomass, and be fairly unproductive (Rackham 1988). However, the canopy was not continuous, and herb communities are consistently represented (Edwards and Ralston 1984). The vegetation would be naturally open above 750m, and on unstable soil (JG Evans 1971a), but the effects of grazing animals, beavers, tree falls, and human activity seem to have produced occasional glades in most areas throughout the Boreal and Atlantic. The change from tundra to forest is often portrayed as a decline in the productivity of the environment, but most tundra biomass is in the plants roots, and as inaccessible as that contained in trees. Forest has a greater variety of plant foods, and a more regular and varied supply of game species, even if the seasonal abundance of migratory tundra animals is absent (Rowley-Conwy 1982).

The traditional view of the Mesolithic people having minimal impact on their environment has largely been superseded. Vegetational disturbance has been recorded in Atlantic, and occasionally Boreal, pollen spectra from all over Britain, and less frequently from Ireland (AG Smith 1970). These disturbances seem to represent forest clearances,

usually of a temporary nature, but under certain conditions having long term results. The natural height of the Atlantic tree-line seems to have been about 650m, with evidence for trees at over 600m in west Wales (Jacobi 1980b), and up to 760m in the Lake District (Caseldine and Maguire 1981). However, this natural tree-line was not reached in several areas, on the North York Moors and the Pennines it was little over 300m (Simmons 1975). In Dartmoor subfossil wood remains are restricted to land below 415m, despite the fact that *"on climatic grounds there seems no reason why the whole of Dartmoor should not have been forested during Flandrian I and II"* (Caseldine and Maguire 1981 p3). There is also no evidence of tree growth above 240m on Bodmin Moor, and Exmoor was probably similar (Caseldine and Maguire 1981). All these areas had a Mesolithic presence, and most have evidence of early vegetational disturbance. On the North Yorks Moors, in pollen zone VI, vegetational disturbance was substantial enough to result in erosion, and the deposition of silt layers in the peat (Jones 1976). On Dartmoor and at Stump Cross, Grassington disturbance events are stratigraphically related to scatters of Mesolithic flints (Simmons 1969).

Bush and Flenley (1987) found evidence of disturbance in the Yorkshire Wolds from 8900 BP, and suggest that this area may have remained fairly open throughout the Flandrian. Robinson (1983) found vegetational disturbance on Arran before 7900 BP, and disturbances in the eighth millennium BP have been recorded in East Anglia (Simms 1978, AG Smith *et al* 1989). Most lowland disturbances appear to be small scale, and temporary, but on sandy, acid soils early vegetational disturbance seems to have caused long term environmental change. At Iping Common (Keef *et al* 1965) the replacement of hazel woodland by heath was associated with the presence of Mesolithic activity. A similar phenomenon was also seen at Oakhanger (Rankine *et al* 1960), where disturbance caused significant erosion within the Mesolithic period. Rackham (1988) claims that even the regular use of fire could not create heathland from woodland, but it could keep clearings open, and aid in leaching, so helping to cause soil change. On sandy, infertile soils nutrient loss and summer drought would hinder regeneration of woodland after clearance (Limbrey 1978).

While such early disturbances in the pollen record are now widely known, the anthropogenic nature of these cannot be assumed without consideration of the alternatives. Forest disturbance episodes, indistinguishable from anthropogenic ones, have been identified as far back as the Hoxnian, possibly suggesting a natural cause for at least some Holocene clearances (Coles and Orme 1983). A tree falling in a forest will leave a clearing in which a vegetational succession will take place in much the same way as in an anthropogenic clearing. However, a single tree fall would produce a clearing too small to

register in a pollen diagram, unless the sample site was very close. Disturbances detected by palynology are generally large enough to have a significant effect on the regional pollen rain. These are probably best detected by sampling in the centre of large bogs or in lakes (Edwards 1982).

Most early pollen evidence is from smaller collection sites or peat deposits where the local pollen component can cause confusion. A small Swiss lake site studied by Tauber (quoted in Rowley-Conwy 1981) showed a drop in water level coinciding with a "clearance" event. He calculated that an increase in the belt of alder and willow round the lake, resulting from the drop in water level, would increase filtration of other tree pollen, and produce an effect indistinguishable from a clearance episode. Few other studies have considered this effect, so it is difficult to judge how important it might be. However, it seems unlikely that all "clearances" from different periods and locations can be explained in this way, especially more long lasting ones.

Intensive grazing can produce grassland or forest clearings. This effect was more pronounced in previous interglacials, when presumably the presence of larger grazing species resulted in larger clearings (Rackham 1986), but it may account for small clearings during the early Holocene, and later ones at forest edge locations (Edwards 1985). Large herbivores may initiate the development of a clearing, and certainly play an important part in keeping clearings open, by preventing regeneration (Moore 1988). Another natural cause of forest disturbance, rarely discussed, is the beaver. Beaver remains are widespread in British Mesolithic contexts, if not very numerous (Coles and Orme 1983); though there is no evidence for it north of a line from East Yorkshire to Somerset (Andersen *et al* 1990). The size and duration of beaver ponds is variable, but when the dams are breached they leave fertile meadows, which would be ideal for ungulate and human use. Coles and Orme (1983) claim that "*the beaver as an agent of landscape change is second only or equal to Man*" (p100).

The occurrence of artefacts at the same level as disturbance events is suggestive of human influence. Simmons and Cundill (1969) investigated a peat section from the North York Moors which had a microlith *in situ*. Disturbance in the pollen spectrum was evident at the level of the embedded microlith. In this case the monolith was in peat, but Cundill (1989) has warned against similar conclusions taken from relationships between flints and pollen in mineral soil. This association is more likely to result from the movement of both pollen and artefacts through the soil by soil fauna. The association of artefacts with clearance indicators may merely suggest that people took advantage of

natural clearings caused by ungulate grazing pressure, or beaver dams (Edwards and Ralston 1984).

More significant is the common, though not invariable, association of early disturbances with the appearance of microcharcoal in pollen preparations. Microcharcoal fragments can be counted in pollen preparations, to identify peaks in concentration that represent burning episodes. The size of charcoal particles may give indication of whether burning was local or not; small particles representing regional background events, and large ones local events. The pollen of pyrophilic plant species can be used to indicate effect of fire on vegetation, but they may increase due to clearance, and soil changes unrelated to burning (Carter 1986).

The presence of microcharcoal and pollen of pyrophilic plant species suggest many of these disturbances were created by burning. It seems unlikely that deciduous forests in such a damp climate as Britain's could easily catch alight; "*British woodlands (except pine) burn like wet asbestos*" (Rackham 1986 p72). They are hard to burn even when felled, and woodlands did not burn even during the drought of 1976, which coincided with the height of stubble burning (Rackham 1986). Lightning strikes have caused fires in south-west Scotland in the historic period, but presumably on moorland and pine forest, rather than deciduous forest (Carter 1986).

The present consensus is that these fires are most likely to have been caused by human activity rather than natural agencies, and the more inflammable forest edge conditions, and drier forests on well drained soils seem to have been exploited (Mellars 1976). Heather would burn far easier than woodland (Simmons and Innes 1988), so both natural and anthropogenic fires may have been concentrated on the forest edge. Fire is likely to have had a more profound effect at the forest edge, where the ecology is more fragile, and susceptible to change (Edwards 1982). It would seem to be difficult to separate fires caused by lightning or human activity in areas whether the former is likely to occur. In these more inflammable areas it would also be difficult to distinguish between accidental burning, e.g. caused by a domestic fire getting out of control (Edwards and Ralston 1984), and deliberate burning for woodland or game management. Where charcoal occurs within areas that were fully wooded, it would seem that deliberate fire setting would have been necessary, though examples of burning in these areas are few.

Unfortunately, palynology cannot demonstrate the anthropogenic cause of fires (Carter 1986). Charcoal has been found in pollen samples at times and places where people are not known to have been present (McIntosh 1986). In many cases this may merely reveal the limitations of the archaeological knowledge. Birks (1972) questioned the early

presence of charcoal in pollen preparations from the uplands of south-west Scotland, because Mesolithic activity had not been found there when she was working. Later field work demonstrated that there was considerable early activity in the area. Edwards (1990) similarly questions the presence of charcoal from pollen preparations from South Uist, where Mesolithic activity is presently unknown. However, considerable field work is necessary to locate Mesolithic sites, especially where ploughed fields are rare, so it is hard to define areas where there has been no human influence, only where there has been inadequate research (Edwards and Ralston 1984).

Simmons has carried out work on microcharcoal evidence on the North York Moors, and has produced considerable evidence that repeated burning occurred, sometimes over large areas. At North Gill (Simmons and Innes 1988) a series of bore holes were used to establish the extent of the main burning episode. This was shown to be 375m long and 30-45m wide, situated at the ecotone between mixed woodland, and more open pine-birch woodland. The size and situation of this burnt area is very similar to that predicted by Mellars and Reinhardt (1978) for maximum resource yield using burning as a method of forest management. Several burning events were detected at North Gill, and another study used fine resolution pollen analytical techniques to analyse one of the clearance episodes (Simmons *et al* 1989). This revealed a more detailed picture of clearance and regeneration events not seen using cruder techniques.

Where larger areas are burnt, fire may have been used for driving game, the first burning event at Machrie Moor involved the burning of reeds rather than forest, and may have been for this purpose (Robinson 1981). Additional benefits arising from such fires would, therefore, only be coincidental. Whatever the original aims of the burning activity, the benefits of forest management are significant for the hunter-gatherer. The reduction of undergrowth and dead brushwood improves mobility in the forest, and makes quarry easier to spot. Most importantly experiments suggest that burning would improve the quality and quantity of browse after the first couple of seasons (Simmons 1975). Burning stimulates vigorous new growth, and reduces the height of the vegetation, so it is more accessible to ungulates. The increased light reaching the forest floor encourages the growth of understorey plants, and increases the carbohydrate content of their leaves (P Evans 1975). While increase in quantity of browse is important, the quality is more so. Groenman-van Waateringe (1986) quotes grazing experiments showing that grass grown in more open environments is clearly preferable to cattle. Unlike deer, cattle have a limited capacity to digest leaves, and benefit from grass in their diet. This abundance would attract animals to the clearing, concentrating their normally dispersed numbers, and facilitating hunting. The improved nutrition would increase the growth rate of the young, and improve

the fertility of the adults. Mellars and Reinhardt (1978) claim that the production of animal protein can increase by as much as 500-900% in a properly managed woodland. In addition to benefits for hunting, fire would stimulate the growth of fruit and nut trees, and other food plants that require some sunlight.

Ethnology suggests that systematic burning was common among many hunter-gatherer groups living in woodland environments. It was used to keep meadows open to improve ungulate densities. Burning in early spring can warm the soil, and accelerate new growth, and the ash provides sodium, the shortage of which can be a significant limiting factor for ungulate populations in northern forests. The maintenance of grassland eases travel, improves berry production, reduces some insect pests, and fire killed trees are a good source of dry fire wood (Lewis 1982). There are ethnographic examples from North America of reed burning in order to improve nesting and feeding areas for ducks and geese (Lewis 1982). Coy (1982) suggests that the use of dogs and clearance to facilitate hunting in the woods in modern Europe could parallel Mesolithic activities. Lewis (1982) considers that the careful planning and seasonal nature of fire management may be comparable to agricultural activities, and it does seem to be part of an intensification in gathering which may be a parallel adaptation to agriculture. Burning can clearly be used as a major force to manipulate forested environments, but even its use by recent hunter-gatherer groups cannot demonstrate that it was deliberately used in this way in Mesolithic Britain.

From the ethnographic studies it can be assumed that burning for forest management would involve many successive fires as the effects are lost after 15-25 years. Only North Gill (Simmons *et al* 1989, Simmons and Innes 1988) has provided evidence for successive fires, but this is mainly because no other site has been studied in the same detail. However, ethnographic parallels for woodland management, especially by fire, must be used with caution because of the differences between British trees and those found elsewhere. In particular British trees are hard to kill, and to set fire to (Rackham 1986). It is also impossible to demonstrate whether burning, and its effects were deliberate or not (Edwards 1990), though it seems unlikely that advantages of burning would go unnoticed, even if early fires were accidental.

P. Evans (1975) emphasises the probable close relationship between hunter and prey, especially where certain species were concentrated on. It seems probable that this relationship encouraged Mesolithic forest management, and possibly lead to several independent occurrences of the domestication of aurochs in Europe. The feeding, and even penning, of wild ungulates, has been claimed for the British Mesolithic based on the occurrence of very high ivy pollen values in buried soils. This insect-pollinated plant

usually forms a very small proportion of the pollen count, but has occasionally been found in very large quantities. As it is an evergreen it could provide a source of winter feed, it is acceptable to livestock in moderate quantities, and has been used as fodder in historical times (Simmons and Dimbleby 1974). These peaks of ivy pollen also occur in Neolithic and Bronze Age contexts, and Drewett (1989) considers then to be so wide-spread that a natural cause of the pollen concentration is more likely. A peak in ivy pollen occurs at Oakhanger, a Mesolithic site in Hampshire, but there other pollen taxa decline, and the authors consider that the high proportion of ivy may be a statistical effect (Rankine *et al* 1960). Though, on some later sites in Switzerland manure has been found containing high concentrations of ivy pollen, supporting the contention that it was used as a fodder plant. Red deer will eat ivy in winter, and it is possible that this was noticed and exploited by Mesolithic people (Simmons and Dimbleby 1974). However, many locations where these high values are found are occupation sites, and it is possible that ivy was collected for other purposes, e.g. making baskets, rather than as cattle feed (P. Evans 1975). Intensive exploitation of deer or cattle during the Mesolithic, therefore, seems probable, but specific evidence for it is inconclusive.

Woodland management would appear to have been beneficial to the Mesolithic population of Britain, and it is probable that forest disturbances were deliberately created for this purpose, though actual evidence is poor. The problem then is to separate this activity from that associated with agriculture. Figure 4.2 shows dated disturbance events (excluding elm declines) throughout the fourth millennium bc, and distributed across the whole country²³. A small number of dates for evidence of cultivation and early cereal-type pollen also fall in the first half of the fourth millennium bc. A phenomenon called the elm decline has been associated with agricultural activity (see below section 4.4), and the majority of reliable elm decline dates fall after 3500 bc (figure 4.4). Some of the clearances do involve a decrease in elm, though not enough for the relevant authors to refer to them as an elm decline; many elm declines also involve a decline in other arboreal pollen. While clearances continued throughout the fourth millennium elm declines would appear to be a new feature starting after 3500 bc, though these events are not necessarily related to agriculture (see below section 4.4). Early dated cereal-type pollen is rare and suffers from various problems that might cast doubt on these early dates (see below section 4.5). Recognising the introduction of a new subsistence type through vegetational disturbance

23. These dates have mainly been collected from Radiocarbon, with some from other sources, as referenced in the catalogue. Dated events shown in this graph include vegetational disturbances referred to as clearances in the source material, as opposed to elm declines. In most cases the reliability of the interpretation of the diagrams or the closeness of the dated to the clearance event has not been checked.

would seem to be difficult, largely due to uncertainty about what anthropological or natural events the pollen data represents.

Not all early disturbances are associated with charcoal horizons, while some later ones are. At some sites e.g. Braeroddach Loch (Edwards 1975), and Loch Doon (Carter 1986) a significant increase in charcoal does not occur until the Bronze Age, whereas elsewhere e.g. Pawlaw Mire (Sturludottir and Turner 1985) the use of fire is evident before the elm decline. Note 4.1 lists events occurring around the elm decline in various diagrams. The study of microcharcoal is relatively recent so it was mentioned in only a small number of cases. Of those the majority showed a peak in charcoal around the elm decline, though several showed a distinct drop in charcoal, and some showed no change. This makes it hard to identify charcoal with a particular type of land management. However, the change in frequency of burning events is suggestive that the burning is related to changing woodland management systems, rather than being caused by lightning. The latter might be expected to occur at a fairly constant rate.

The later clearances are not very different in nature to the early ones. Both are small-scale, though many appear to be of considerable duration. Few Mesolithic clearances have been adequately dated to calculate their duration, but that at Hockham appears to last 150 years, and those at Pawlaw Mire about 200-250 years (Sturludottir and Turner 1985). Some Neolithic clearances have been reported to be about 300 years in duration (Rowley-Conwy 1981), though those at Braeroddach loch, Grampian (Edwards 1975), and Ballynagilly, Northern Ireland (Pilcher and Smith 1979) last for approaching 1000 years. There is significant variation among authors of the precise definitions of boundaries to clearance events, and the inclusion of some or all of the regeneration phase in the duration of the clearance makes a significant difference (Edwards 1979b). However, the inaccuracies of radiocarbon dating pollen cores, and the coarse resolution of many diagrams are a much larger source of error.

4.2.2 Sub-Boreal period clearances

Despite there being little change in the character of the vegetational disturbances those dated after about 3000 bc are generally attributed to human activity, presumably by farming communities. Cereal-type pollen is found associated with many clearances around the elm decline, but not all (appendix I, note 4.1). In this period the controversy is directed at other matters, such as how extensive these early agricultural clearings were. Pollen diagrams are poor indicators of the spatial extent of clearances, though occasionally in a small drainage basin the cleared area can be estimated. If pollen samples are taken from a

lake the identification of clearances depends largely on their location in relation to streams in the drainage basin. A small clearance by the edge of a stream may be strongly represented, but a large clearance away from lakes or streams may barely register. Degree of impact on the pollen record, therefore, does not relate directly to clearance size. In bogs a sample site at the edge of a bog might be more likely to detect the presence of a clearance, but bog margins have shallower, and more disturbed peat (Edwards 1982). The centres of large bogs tend to trap more regional pollen (Aaby 1986), and suffer much less from the reworking of old pollen and stratigraphic disturbances (Edwards 1982), but regional pollen rain gives only a generalised image of clearance activity. The restriction of most pollen diagrams to peaty uplands makes them of little use when investigating the areas likely to have the most extensive cultivation. Information in these areas, especially southern England has relied mainly on buried soils, and molluscan studies, which reflect very local conditions.

Entwistle and Grant (1989) claim that early Neolithic clearance is rarely associated with soil erosion, and appendix I, note 4.1 suggests that soil erosion was restricted to northern, upland areas. This may indicate that the clearings were small, and being surrounded by the forest soil stability would be maintained. Soil erosion and over-exploitation does seem to have occurred by the middle of the third millennium bc (Mercer 1981b, RW Smith 1984). In southern England there is some evidence for larger cleared areas, but these were probably under grass, and for purposes other than arable agriculture (Smith 1984). The main purpose of clearance may have been to improve forest quality for livestock. However, while more cattle can be supported on grassland than woodland (Fleming 1972), they do not actually need large clearances (Smith 1984). Alternatively many early Neolithic clearances may have been associated with monument construction, rather than agriculture (Allen *et al* 1990).

In palynology the pollen of weed species is generally used to identify landuse. This has led to various assumptions about the use of early Neolithic clearances, but it is questionable whether, in most cases, pollen of these species can provide the information that is claimed. Surprisingly few grassland plants were introduced into Britain during the Neolithic, most already grew on surviving fragments of late-glacial grassland, and in natural gaps in the woodland, and expanded their range when new habitats were made available (Rackham 1986). Weeds do not, therefore, easily identify anthropogenic from natural clearings. *Plantago lanceolata* is found naturally in unstable contact zones (Annable 1987), such as coastlines or river banks. Some plants common in hay meadows also form part of natural mire vegetation (Janssen 1986). It is particularly hard to identify human activity in pollen diagrams where the vegetation is naturally open, as in the north of

Scotland, and on many Scottish islands. any "cultural" pollens are naturally present, and changes in sea level or degree of exposure will produce changes identical to human interference (Hirons and Edwards 1990). However, many of the sites listed in appendix I, note 4.1 mention the first appearance or increase of *P. lanceolata* at the elm decline, as well as the increase in other herbs. It would seem that herbs expanded to a greater extent during these later disturbances than in the earlier ones.

Most herb pollen produced never travels further than about 100m from its source (Edwards 1982), especially in a wooded environment where the impact of pollen against the trees causes it to be filtered from the air. For example at a Neolithic site in Germany a large village and its fields had been located by archaeology, but these were poorly represented in a pollen diagram taken from only 100m away (Behre and Kucan 1986). At Butser, experimental farm, a field was cropped in a wood for four years, but no effect on the pollen record was detected (Reynolds 1987). The absence of pollen evidence for agriculture can clearly not be used to demonstrate the absence of agriculture in an area, only that no suitable sample sites have been found.

Distinctions between pastoral and arable land use ^{are} ~~is~~ difficult to determine, as pastoral weeds may grow on the edges of arable fields, or on fallow fields (Edwards 1979b). As cereals, and some arable weeds produce little pollen, which often does not travel far pastoral indicators are likely to be over represented (Annable 1987). Though cereal pollen rarely travels far from the parent plant, there is the possibility that occasionally grains may be introduced to areas distant from arable fields, in the air borne regional pollen component, or more likely transported by people as they move grain or straw (Edwards 1979b). In relation to the Transition this may be beneficial if it increase the chances of cereal pollen being identified at a sample site. Even the definition of many species as exclusively arable weeds is insecure; native plants are clearly able to live in other communities, as they did before the introduction of agriculture. *Plantago major* is sometimes assumed to be an arable weed, but it is present on early Holocene grassland on the Yorkshire Wolds (Bush and Flenley 1987). Grasses produce large quantities of pollen that carry considerable distances. Grass pollen tends to be the most common of the non-arboreal pollens, and is frequently used to indicate the presence of openings in the forest canopy. However, a change in the frequency of grass pollen may represent a change to species that are more prolific pollen producers, rather than overall increase in grass (Moore *et al* 1986). Increased grazing pressure can also cause a decline in grass pollen, as grazing prevents the grass flowering, though it may encourage the expansion of the grassland (Reynolds 1991). It would, therefore, seem difficult to securely identify clearance type (Edwards 1979b).

Pollen evidence suggests that clearance activity on the Pennines decreased at the start of the Neolithic. The treeline, which seems to have been kept artificially low during the Mesolithic, remains much the same, or in some cases extends upwards during the Neolithic (Simmons *et al* 1982). Early Neolithic arrowheads on uplands imply a continuation of hunting, and some of the remaining clearance activity may have been related to this. Limestone uplands may have been used differently, because of their more fertile soils, and there is some evidence of small scale agriculture in North Yorkshire (Barnes 1982). Alternatively clearance activity could be mainly for the benefit of domestic livestock. The grazing of cattle in improved woodlands at some distance from settlements would leave little archaeological evidence, but would explain the occasional clearance activity.

On the chalklands of southern England there is, as yet, little direct evidence for post-glacial grassland on the chalk, or for Mesolithic clearance (Allen *et al* 1990). The region appears to have been extensively wooded at the start of Neolithic, though Mesolithic activity does seem to have caused the development of heath in places (Sheldon 1978). The range of sites with environmental evidence in southern England is limited largely to buried soils under monuments, or deposits in ditches, making it hard to draw general conclusions about the early Neolithic environment (Allen *et al* 1990). The techniques used have significant limitations, most provide only a very localised picture of the environment. At Bishopstone, on the South Downs, mollusc evidence, and the presence of tree holes demonstrated that the area was wooded when Neolithic settlement was first established. However, the charcoal of shrubs, e.g. hawthorn, ^{was} ~~were~~ present possibly suggesting the existence of secondary woodland, regenerating after pre-Neolithic clearance (Bell 1977). Where a variety of evidence is not available the impression gained of the past environment may be heavily biased.

Pollen and mollusc evidence from ^rMalborough, the Berkshire Downs, the Chilterns, and the North Downs suggest there was minimal disturbance in the forest cover until the Iron Age. Most clearances that did occur, as identified in colluvial deposits, are associated with Beaker and Peterborough ware (Holgate 1988). Pollen from the Vale of Brooks, Lewes, shows the Downs in this area were still wooded in the Neolithic, with no significant clearance occurring until the Bronze Age (Drewett 1978). This is supported by the scarcity of polished stone axes in this area (Bell 1977). Mollusc and charcoal evidence at ^ssome Neolithic sites suggests limited clearance round the sites (Drewett 1978). The Conebury anomaly produced evidence for small-scale, localised clearance, and the pre-enclosure settlement at Durrington Walls is possibly associated with clearance and

cultivation (Allen *et al* 1990). Mollusc evidence suggests the Dorset cursus was built on fairly open environment (Bradley *et al* 1984).

Dimbleby and Evans (1974) have conducted studies of buried soils under Neolithic monuments in Wiltshire, locating several examples of pre-construction clearance, some of which is associated with rather unsatisfactory radiocarbon dates. The use of both molluscan and pollen information allowed their comparison, and a clearer identification of actual events from taphonomic effects. South Street, Beckhampton Road, Horslip, and Ascott-under-Wychwood long barrows, Avebury, and Durrington Walls produced evidence for woodland clearance, in some cases with some regeneration of woodland or scrub before the monument was constructed. In contrast buried soil from beneath Windmill Hill and Knap Hill had woodland species throughout the profile. The soil under many of the long barrows had developed into rendzinas, typical of chalk grassland, indicating that some areas had been open for a considerable time (Dimbleby 1976b). The date of:-

5190±150 BP (3240bc) BM-180

for an antler pick from the ditch of the Horslip long barrow has been discussed above, and might, with reservations, be taken as a rough indication of the *terminus post quem* date for the clearance activity. A large patch of charcoal from beneath the surface of the buried soil under the Beckhampton Road barrow was dated to:-

5200±160 BP (3250 bc) NPL-138

This date is probably too old as the charcoal was oak, but it is closely related to some burning activity, presumably associated with woodland clearance. Reddened zones, both above and below the charcoal deposit, suggested a fire smother under soil or turf, implying the deposit may have been rapidly covered, and little contaminated by earlier or later material.

Patches of oak charcoal were also dated from below South Street long barrow. The date of:-

4700±130 BP (2750 bc) BM-356

does relate quite well to two slightly later dates from the mound and ditch (Ashbee *et al* 1979). The date of:-

4893±70 BP (2943 bc) BM-491b

for the pre-barrow Neolithic settlement at Ascott-under-Wychwood (Benson 1971) has already been discussed, and this may be assumed to date the earlier clearance episode seen on the site.

Similar clearance evidence has been found in Scotland. Dalladies long barrow, Grampian, is dated by two dates on the second phase of the timber mortuary structure:-

4660±50 BP (2710 bc) SRR-289

4535±55 BP (2585 bc) SRR-290

Analysis of the ^{curves}~~teries~~ used to construct the mound suggested they were cut from soil that had formed under woodland. Charcoal in the A horizon indicated this woodland had been burnt, and grassland developed, from which the ^{curves}~~teries~~ were cut (Piggott 1973, 1974, Romans and Robertson 1975). The buried soil below Pitnacree round barrow, Tayside, was disturbed, and contained weathered pottery fragments, possibly indicating pre-barrow cultivation. A layer of charcoal overlying the buried soil, and stratigraphically directly below the barrow was dated to:-

4810±90 BP (2860 bc) GaK-601

A similar sequence of a thick horizon of probable cultivation soil under a burnt layer also occurred at Biggar Common (Johnston in prep.). Dates of :-

5250±50 BP (3300 bc) GU-2985

5150±70 BP (3200 bc) GU-2986

from the burnt layer suggest a fairly early date for the cultivation activity.

A black layer under the Neolithic barrow at Boghead, Moray, dated by the weighted average of three dates (SRR-684, SRR-686, SRR-689) to:

4873±40 BP (2923 bc)

was originally thought to represent forest clearance. However, plant macrofossils from this layer were predominantly *Cerealia*, with few weed seeds and no rachis

fragments. This assemblage was considered too clean to represent agricultural activity on the site, and the burnt layer was reinterpreted as a funeral pyre (Burl 1984).

The problems of single dates, especially on charcoal have been thoroughly discussed above. None of the sites are well dated, but lacking better evidence it does suggest that clearances occurred at these locations in the late fourth and early third millennium bc. Some of the clearings may have been made specifically for the construction of the monuments, but evidence for cultivation, or a considerable space of time between clearance and the construction of the monument, suggests clearance for more economic purposes. The ard marks and ploughsoil preserved under South Street long barrow are the clearest examples of early agricultural activity. Other clearances seem as likely to be grassland as arable. "Woodland grassland" species can colonise tracks and paths through the woodland (Rackham 1986). The small, but long term pastoral-type clearing identified under Beckhampton Road barrow has been suggested to represent a permanent trackway or junction (Smith 1984). Most third millennium bc monuments are located with concern for visibility over a large area. This would be impossible if there were not considerable, permanent clearings in the forest, possibly made specifically for the monuments, rather than as part of the agricultural system (Fleming 1972, RCHME 1979a).

4.3 Early Neolithic agriculture

4.3.1 Crops

At least some early Neolithic clearances must have been used for agricultural purposes. Cereal pollen does occur in association with many clearances, and plant macrofossils, and faunal assemblages, as well as the appearance of substantial monuments, strongly indicate considerable agricultural activity. Before an attempt is made to discover when this activity first occurred, it seems important to identify the character of established, early Neolithic agriculture.

Early Neolithic agriculture has long been assumed to be based on the swidden, or slash and burn system. The model of swidden agriculture in the European Neolithic was based largely on Iversen's palynological work, his famous demonstration of the efficiency of a stone axe at felling small trees (Iversen 1956), and ethnographic examples of recent use of this practice in Europe. Study of ethnographic parallels, mainly in the tropics (De Schlippe 1956), seems to have instilled a belief that despite the fertility of many European soils that soil exhaustion would rapidly occur on land that was cleared and cultivated, necessitating a long fallow period to return its fertility (Harris 1972). Recent research has led to the questioning of all these points. Recent examples of swiddening are restricted to marginal European habitats, especially conifer forests, on soil so marginal that it was not cultivated until the Medieval period. Sherratt (1979 p314) suggests that "*far from being a 'primeval' agrarian system, swidden agriculture was a characteristic of the most recent phase of the internal colonisation of Europe, when settlement spread to the least fertile soils*".

Neolithic clearances are often characterised by three phases as represented by the pollen types present. A rapid drop in arboreal pollen is followed by supposed arable indicators, then pastoral species, and finally the regeneration of the forest. This was initially interpreted by Iversen (1941) as a single short term clearing of the type used in swidden agriculture, lasting about 50 years. Radiocarbon dating has suggested a much longer duration for these clearances, which has demanded a reconsideration of this theory. Some authors, such as Edwards (1979) have assumed that soil exhaustion will "*inevitably occur*" (p261) after a few years of cultivation, and argue that the clearance episodes seen in the diagrams are an amalgamation of numerous separate clearance events. Yet it seems unlikely that the sequence of vegetational change would be so clear if this were the case (Rowley-Conwy 1981).

The Draved slash and burn experiment produced "*a luxuriant crop*" (Iversen 1956 p39) on the burnt ground, and a very low yield from the unburnt plots. However, the soil was acid and poorly drained, no doubt requiring special treatment before any successful crop could be produced (Steensberg 1979). Reynolds (1977) achieved a similar result in a similar experiment, but probably because fairly marginal land was also used in this case. Both experiments showed the benefits of burning to be short lived. However, the loss of nutrients after burning is unimportant on calcareous soils, where minerals are easily available (Dimbleby 1976b). Experiments on more fertile soils produced very different results to those on marginal soils. A 50 year experiment at Woburn Experimental Station with continuous cropping of both manured, and none manured fields resulted in greater yields from the manured fields, but no evidence of exhaustion in either field. At Rothamsted Experimental Station the highest average yields in a 110 year experiment involving the annual cropping barley came from the last decade of the experiment. These experiments used modern cereals, but evidence from Butser Experimental Farm for emmer wheat supports these results. The crops were grown every year with no fallow, and no nutrients added. After 8 years it was seen that fluctuations in yield were closely related to weather, but even in drought and frost years the seed:yield ratio never fell below 1:7. There was no evidence of soil exhaustion, and as ancient varieties require much less nitrogen than modern varieties this might be expected only on particularly poor soils (Rowley-Conwy 1981). Smith (1984) found no evidence for soil exhaustion in Neolithic buried soils in the Avebury area, though the assessment of the fertility of buried soils is difficult. He claims the evidence is more suggestive of in-field cultivation, probably with manuring, boulder clearance, and burning only to remove weeds and turf remains. Reynolds (1977) found that burning made soil preparation easier, as it destroyed root material, and Steensberg (1979) noted its usefulness in disposing of felled trees, so burning may have had some function in initial land clearance. The repeated process of clearance, cultivation, and regeneration would seem to be "*unnecessary and indeed uneconomic*" (Mercer 1981 pxi) in north-west Europe.

This is especially true if manure was used. Reynolds (1981) found that applying manure once every 3 years significantly increases yield, but encourages weeds. Manure was easily available in the Neolithic, though its use has not been demonstrated before the Bronze Age in Britain (Reynolds 1987). Agriculture was well established by the time it reached Britain, and it seems likely that the use of manure had been developed (Limbrey 1978). An early Neolithic site in Switzerland has preserved remains of what appears to be barn-yard manure that washed into a lake after being spread onto cultivation terraces (Robinson and Rasmussen 1989). Bracken is also a possible fertilizer, and its spores and macrofossils have been found in abundance on some southern English sites associated with

evidence for agriculture. Snail communities suggest that the bracken did not grow at these sites, and was probably introduced by people as fertilizer, or possibly cattle bedding (Dimbleby and Evans 1974).

Modern societies based on swidden agriculture keep few or no animals as these hinder forest regeneration (Harris 1972). Neolithic agriculture was clearly mixed, and presumably the two aspects of arable and livestock were integrated. In a permanent field system livestock can play a very significant role in the maintenance of soil quality, not only by manuring the soil if they are allowed to feed on stubble, but to clear weeds, and break up the soil. The fertility of the soil, and the integration of livestock into the farming system makes *"slash and burn....an unlikely option in the temperate European Neolithic"* (Rowley-Conwy 1981 p95). If early arable fields were permanent clearances they could have been small, as only a few acres would be sufficient to feed a family (Legge 1989). However, for cereals to ripen shading must be minimal, and clearings may have been much larger than the land area needed for the fields (Limbrey 1978). Such clearings would probably appear in the pollen record as grassland, as pastoral indicators would swamp the arable pollen taxa.

Evidence for other aspects of early agriculture are rare and often controversial, but some methods and techniques can be suggested. The use of an ard in early Neolithic Britain has caused some discussion, but there is now some agreement that a rip ard was used to bring land into cultivation. Apparently the earliest example of this was preserved under South Street long barrow, Wiltshire, and probably dates to the early third millennium bc (Ashbee *et al* 1979), though the single date from the old land surface is hardly reliable. The ard marks cut up to 15cm into the subsoil, and were mostly straight and of varying length. The marks suggest more than one phase of land clearance, and a relatively chalk free zone in lower part of the buried soil profile implies two cultivation phases with a gap between (Fowler and Evans 1967). In some European examples of preserved ard marks seven different ploughing phases could be seen (Kristiansen 1990). An upper chalk free zone in the profile suggests a fallow stage of 7-10 years before the construction of the barrow. Mollusc evidence from the site supports the claim that an area of woodland was cleared, and remained open until the barrow was built (Fowler and Evans 1967).

Though ploughing marks under some Neolithic and Bronze Age barrows are of a ritual nature, e.g. at Lundehøj, Denmark (Rausing 1988, Rowley-Conwy 1987), most can be adequately explained as agricultural activity (Kristiansen 1990). There were some objections to this interpretation as the marks were clearly not the result of ordinary

ploughing, but they are consistent with the use of a rip ard. Rock carvings and modern ethnographic parallels suggest these were used to break up the soil and root mat, prior to the use of mattock hoes to produce a tilth. These ards cut deeply into the soil and subsoil, and can be used in woodland and grassland, unlike other types of ard or plough (Reynolds 1981). Experiments have shown the ability of rip ards to break up an area of grass, especially when used with burning to help loosen the vegetation cover (Kristiansen 1990). Fleming (1972) assumes that ard marks imply stump free terrain, rather than recently cleared woodland, but the rip ard is specially designed for clearing woodland, and grassland (Reynolds 1981), and the curved grooves under South Street long barrow (Fowler and Evans 1967) may be accounted for by the avoidance of tree stumps.

The farming year seem to have been organised to spread the work load more evenly. While emmer, the most commonly found wheat, could be sown in either spring or autumn Hillman (1981) suggests that barley and beans are better suited to spring sowing, and so to spread the harvest times emmer would be sown in autumn. This theory can actually be tested as the arable weed *Galium aparine* is an indicator of autumn sowing, and is not present among spring sown crops (Reynolds 1981). Seeds of this species were found on a Neolithic site submerged in the Blackwater Estuary (Murphy 1989), suggesting this degree of planning and maximising efficiency was practiced at least in parts of Britain.

4.3.2 Livestock

Livestock were probably an important element in early Neolithic agriculture, as draught animals and to help improve soil fertility as well as for food. Though wild species are found on Neolithic sites, the faunal assemblage is normally dominated by domestic species, which usually represent most of the meat weight. Cattle can be supported at greater density in a forest than red deer, and the introduction of domestic cattle would have increased the available meat quantity, as well as making this easier to harvest (Fleming 1972).

There is a lack of large faunal assemblages from the early Neolithic in Britain, except from causewayed camps which are probably neither particularly early or typical examples of Neolithic economy. The evidence can do little other than indicate the presence or absence of various species (Kinnes 1988). It is assumed domestic species were imported rather than locally domesticated, though this assumption "*lacks confirmation*" (Kinnes 1988 p2). Though cattle were native to Britain, there is no conclusive evidence for native domestication (Case 1969). Noddle (1989) claims that early English domestic cattle were sufficiently different to the wild species to suggest they were imported stock. Alternatively

Isaac (1971) suggests the variation in size in domestic cattle across Europe may indicate local domestication, though it could be due to deliberate selection, or a low level of husbandry skill. The species are identified largely by size, and though the size ranges are quite distinct as long as the gender of the bones can be identified, this is often not possible and confusion between wild cows and domestic bulls confuses any interpretation of the pure nature of domestic herds (Grigson 1978).

The identification of wild and domestic pigs suffers similarly. Comparisons between cattle and pigs found on Mesolithic and Neolithic sites is rarely possible because of the scarcity of large Mesolithic faunal assemblages. Sheep were not native to Britain, and would have to be imported (Noddle 1989, Ryder 1983). Ryder (1983) makes a claim for sheep on a Mesolithic site in Devon, but does not name the site, and it would seem possible that this was a misidentified roe deer. A bone supposedly from a very small domestic sheep found in the bottom of a late Mesolithic pit at Farnham, Sussex, has also probably been misidentified, and the bone now appears to have been lost (Ellaby 1987, Jacobi 1978).

Livestock husbandry seems to have been as sophisticated as the arable regime. There is no evidence of ill-fed, poorly managed cattle (Legge 1981), and British Neolithic cattle are sufficiently different to wild cattle to suggest they were bred from imported domestic stock, and interbreeding with wild cattle was largely prevented (Noddle 1989). The product of 1km² of forest might provide enough leaf fodder for a herd of 50 cattle through the winter, with a similar number supported by summer browsing, so mass slaughters in autumn would not be necessary (Fleming 1972). Fodder production must have been an important element in the farming economy (Reynolds 1987). On some sites pigs were of some importance, they would need to be stalled over winter to maintain their domestic relationship with people, and ensure breeding with domesticated boars. Though they would need feeding only a small number need be kept over winter to ensure the maintenance of the herd. Pigs have short reproductive cycles, and large litters, so they have a great capacity for reproduction. only a few and still ensure the herd will be maintained. Pigs can be important to arable cultivation as they root up weeds, they are particularly useful in keeping clearings free of bracken, which cattle and sheep will not eat (Grigson 1982).

There is some argument over the possibility that Neolithic husbandry may have concentrated on the production of milk rather than meat. Entwistle and Grant (1989) consider this to be unlikely because of low milk yields in early breeds. A predominance of adult female cattle in faunal assemblages are often interpreted as evidence for dairy herds, though even in a meat herd males will be preferentially killed to leave the maximum

number of females to ensure the continuity of the herd. The special nature of causewayed camps, from which much of the Neolithic faunal evidence comes, makes it unlikely that the assemblages represent the every day economy or slaughter patterns. Legge (1981) also stresses the unusual nature of these assemblages, but argues that the high proportion of female cattle does suggest dairy herding, as animals were surplus to the herd, not normal meat animals. He argues that milk production is more sensible than meat production as part of a subsistence economy as it minimises the number of livestock, and maximises output. Milk is also a form of fat that is easily converted for long term storage, and trade, and that is available without killing the cow. The problems of lactose intolerance in a community that has only recently adopted husbandry are of little significance as processed milk contains little lactose (Legge 1989).

4.3.3 Wild species

Farming did not bring the end of hunting and gathering in early Neolithic communities. Remains of aurochs, wild pig, and deer were found on every Neolithic site investigated in the Avebury area, along with wild plants such as hazelnuts, crab apples and sloes (Smith 1984). Moffett *et al* (1989) studied the floral remains from 24 Neolithic settlement sites, and found wild food plants on all but three, and hazelnuts on all but five. Crab apples are abundant on some sites, and raspberry, blackberry, sloe, hawthorn, carbonised roots, and rhizomes were also found. Hazelnut shells were probably deliberately burnt to dispose of them, making them likely to be over represented in an assemblage of charred remains (Legge 1989). The practice of counting of hazelnut shell fragments also distorts the proportions of this species (Moffett *et al* 1989). Other fruit species are highly unlikely to be charred and preserved, so their economic importance is very difficult to judge. Equally problematic is the use of the term "wild". Legge (1989 p222) suggests that "*hazelnuts and crab apples are as likely to be cultivated as wild in the Neolithic*". Reynolds (1987) considers nut trees to be poor candidates for cultivation as they do not fruit annually, and do not bear nuts until mature. The earliest example of woodland management was the coppice woods maintained on the Somerset Levels, and used to provide wood for the trackways (Rackham 1986). Coppicing clearly occurred from the early Neolithic, and it seems likely that fruit and nut trees growing on the edges of fields were encouraged and tended, though true cultivation of these species cannot be demonstrated. While hazelnuts seem to have been widely used throughout the Neolithic it is unlikely that they were of great economic significance. They are not easily stored, requiring to be stored in cool, dry place when fully ripe, and are time consuming to process as each shell must be broken individually (Legge 1989).

Entwistle and Grant (1989) have argued that cereal cultivation may have been much less significant in the Neolithic than usually assumed. However, their argument is based on the scarcity of Neolithic cereal remains, which is due largely to the small number of settlement sites excavated; cereals are unlikely to have been stored or processed on funerary or ritual sites (Legge 1989, Moffett *et al* 1989). The apparent unsuitability of Neolithic pits to grain storage might suggest that grain was stored in structures rather than in the ground; a possible explanation for the presence of grain in the foundation trenches of Balbridie timber hall (Ralston 1982). Only a few cubic meters of grain would need to be stored to feed a family group, and ensure enough seed corn (Legge 1989), so storage would not have been problematic. The importance of agriculture in a prehistoric economy must be judged by other data than actual remains, e.g.. size and complexity of settlements, and the scale of monumental construction (Legge 1989). Unfortunately this too can be deceptive as monument construction and larger settlements can be supported by a largely hunter-gatherer economy, as occurred in the Woodland period in Midwestern North America (O'Brien 1987).

Charred plant remains found during excavation are often used to elucidate crop types and processing methods, but as Legge (1989 p220) stated "*every edible seed that was charred was a miniature disaster*", an abnormal occurrence, from which it is hard to deduce normality. Charring is often explained as accidental burning during parching of the grain before storage, but Reynolds (1987, 1991) claims that this process is unnecessary, the idea being based on ethnographic examples from the Western Islands of Scotland where the unusually wet climate made parching necessary. He believes charred grain is much more likely to result from other activities, such as cleaning straw for thatching, making it highly unlikely that preserved remains are representative of crop proportions or crop processing methods (Reynolds 1981). Though seeds of arable preserved in a posthole on a Neolithic site in the Blackwater Estuary, Essex, strongly suggest crop cleaning waste (Murphy 1989).

4.4 Elm decline

4.4.1 Synchronicity

The phenomenon of the elm decline has been recognised, and widely discussed by palynologists. It is traditionally perceived as being a single, cataclysmic event in which the population or pollen production of elm trees across Europe was substantially reduced within a short period of time (Garbett 1981, Smith and Pilcher 1973, Smith 1970). According to Huntley and Birks (1983) the elm decline occurred between 7,000-6,500 BP in south-east Europe, and 5,500-5,000 BP in northern and north-west Europe. It is usually associated more, or less, closely with the beginnings of agriculture in Britain.

In Britain the elm decline is the most frequently dated pollen horizon, despite the assumption of its synchronicity has been argued to make dating at individual sites unnecessary. Smith and Pilcher (1973) used radiocarbon dates to assess the synchronicity of several Flandrian pollen horizons. Most covered 1000 years or more, but the dates presented for the elm decline were extremely close, suggesting a synchronous horizon, at around 3,000 bc. However, only a small number of dates were used, and these now do not appear to be fully representative of the elm decline in Britain. Smith and Pilcher's work is widely quoted as a demonstration of the synchronicity of the elm decline despite the small number of dates used (e.g. Moore 1985).

The concept of synchronicity has been questioned, with the wide variation of dates for the elm decline in some regions being emphasised. Annable (1987) notes a range of nearly 1000 years for elm declines in northern England. In southern England it occurs between ca.5600 and 4800 BP, though it is not seen in all diagrams, causing Schofield (1987) to see this supposedly uniform event as representing little more than "*a degree of sporadic, patchy clearance*" (p275). The establishment of a definitive date for a pollen horizon is beyond the scope of this study, but it is necessary to investigate the dating of the elm decline if this is to be compared to the start of the Neolithic, and the possible relationship between the two events is to be examined. The dates used in the present study include most of those available for the period before 3000 bc, the large majority of these are discussed as "primary elm declines" by their authors. The identification of the primary elm decline is not always simple. Where elms regenerate well after the decline a second elm decline may be more dramatic than the first. In other cases elm declines along with other trees in much the same way as it has throughout the Atlantic period. Later declines may be clearer, but not essentially different to earlier ones. In some cases the rule seems to

be that the primary elm decline is any decline in elm close to 3000 bc, which adds a certain circularity to the synchronicity argument.

A less extensive search was carried out for elm decline dates after 3000 bc to obtain some indication of the full national range of the elm decline; the part of the graph extending after 2500 bc should be taken as a rough indication that some later elm declines do exist. Where these have been referred to as secondary elm declines in the source of the information this is indicated in the catalogue. Because most of these later dates were collected from Radiocarbon, and the original articles were not checked some of these later dates, not specified as such may be secondary elm declines.

Figure 4.3a shows all the catalogued elm decline dates, which apart two very early dates these extend from ca.4300 bc to ca.2200 bc, 2100 years. Some of these are probably secondary elm declines, those specifically referred to as such seem to fall in a group after 2000 bc. In calibrated terms (figure 4.3b) the range is from c.5300 to c.2700 cal.BC, 2600 years, the slightly longer period being accounted for by the larger errors as calibration has not changed the position of the dates in relation to each other. These dates include some which are fairly poorly related to the elm decline, for many more I have been unable to obtain detailed information about this relationship. Other dates are interpolated, i.e. the event is not dated directly, but calculated in relation to dated samples on the core. This combines all the errors associated with the dated samples with the assumption, often unsupportable, that there are enough dates on the core to estimate peat accumulation accurately. Interpolated dates are, therefore, not very reliable.

The dates were submitted to a rough selection procedure, and the accepted dates are presented in figures 4.4a and b. Dates were rejected if there was evidence in the pollen profile of erosion at the elm decline. This may cause the introduction of reworked material and make the dates too old, in some cases it is evident in the dates as date reversals, but profiles are rarely dated well to be sure of recognising this. Cores dated with only one or two dates were rejected, as were interpolated dates. Dates were accepted where samples were taken over the duration of the elm decline, or preferably covering a specified part of the curve. I have relied on the original author for the interpretation of the dated event as the primary elm decline. It would seem desirable for a more thorough and definitive study to be carried out by a palynologist, involving independent assessment of pollen diagrams, and stricter criteria in selecting dates.

The range of accepted dates is very similar to the previous graph, the earliest dates have been lost, but there is a range of over 1500 years, the majority falling within a 1000 year span. In both figures 4.3 and 4.4 most regions of Britain have a full range of

dates, with no geographical trend in evidence. The range could be partially produced by dates being on different parts of the elm curve. Dates from the start of the elm decline (figure 4.5), and immediately before it do seem to be earlier than some of those on the end of the decline. As the event being dated is often estimated at being one or two hundred years in duration, a period often exceeded by the error on the dates, this effect is probably minimal. Dates spanning the decline also cover the full range of dates.

Of the accepted dates the early date from Wales (SS1) is so different to the rest of the dates in this area that it is probably anomalous. There are two early dates from Upper Teesdale (NY14), which is well within the distribution range of elm, and climatic factors should be no more severe than other northern English uplands, e.g. the Lake District where the elm decline is well dated significantly later. This suggests that the elm decline here may be of the same character as later ones, but is genuinely early.

In most parts of Britain the elm decline seems to have first occurred at about 3500 bc. It occurred repeatedly at different sites in the same areas at various times into the third millennium bc. Multiple elm declines are being more frequently recognised and studied. They are best detected by multiple cores from one site, but as this is expensive and time consuming it is rarely carried out (Whittington *et al* 1991). This approach was used at Waun-Fignen-Felen (SS1), Powys (Smith and Cloutman 1988), and Black Loch (NS2), Fife (Whittington *et al* 1990, 1991), the latter having two main elm declines and one minor one, and the former up to 4 elm declines of varying magnitude. A second elm decline, usually dating to the Bronze Age, has been reported from several diagrams in Britain, Ireland (Hirons and Edwards 1986), and Denmark (Aaby 1986). The data base presented here seems to suggest the existence of multiple declines in most regions, though no overall trends are apparent. This is largely due to the large error on the dates, it being impossible to identify laboratory error from a genuine difference in date. If elm decline events occur repeatedly throughout the late fourth, and third millennia bc, as may be interpreted from the evidence, this would present a very different view to the traditional one of a decline in elm pollen occurring all over Britain within little more than a 200 year period centred on 3000 bc (Groenman-van Waateringe 1983). It may equally be possible that this effect is due to the large errors of radiocarbon dating combined with considerable uncertainty about what material is being dated. Possibly dates on peat and lake deposits are incapable of identifying a synchronous event, and whether events occur with 100 or 1000 years the dates will be similarly wide spread. This equally applies to archaeological dates, but several dates can be taken on one feature to reduce the combined error. It may be possible to achieve a similar increase in precision by taking dates on the same pollen event from

different cores in one area, though variations in deposition rate might make the combination of such dates unjustified.

The basis of the problem as related to archaeology is largely a lack of understanding. The term "synchronicity" is no doubt used in preference to "contemporaneity" because it is not intended to imply a precise temporal relationship. Archaeologists, and some palynologists, seem to have misinterpreted or misapplied this term, being confused by the falsely precise use of central dates, and the repeated assurance that the elm decline covered a few hundred years around 3100bc. It might be questioned whether palynological evidence can ever be related to archaeological events precisely enough to support archaeological theories, such as the theory that agriculture was practiced in Britain in the early fourth millennium bc, discussed below.

4.4.2 Causes

Elms are, according to Rackham (1986) "*the most complex and difficult trees in western Europe, and the most intimately linked to human affairs*" (p232). The elm decline has for a long time been associated with the first introduction of agriculture to Britain, whether its causes have been accepted as anthropogenic or not. Some recent articles have argued against the importance of this event as an agricultural indicator (e.g. Groenman-van Waateringe 1983), but its cause is far from understood, and cannot be excluded from a discussion of early British agriculture. A brief discussion of suggested causes is presented to assess the probability of the elm decline being related to agricultural activity.

4.4.2.1 Climatic and edaphic

Iversen (1941, quoted in Garbett 1981 and Moore 1985) originally suggested climatic change as an explanation of the Holocene elm decline. The change in climate from the Atlantic period to the sub-Boreal is not clear in Britain, neither pollen nor peat give a clear indication of drier climate as occurred on the Continent (Evans 1971a). There seems to have been a short period of cold climate in the northern hemisphere between 5,400-5000 BP, but it is hard to separate the results of human activity from climate change, and independent evidence of climate change at this time is inconclusive and unquantifiable (Moore 1975). However, even if climatic change were demonstrated the detailed evidence of the elm decline does not fit well with this hypothesis. *Ulmus glabra*, which is assumed to be the most common elm species in the European climax forests, is actually quite

resistant to frost, and if the climate was severe enough to effect it, other less hardy species would also suffer. Other arboreal species often do decline at the elm decline, but these tend to be oak, and some times birch, which are hardy trees (Moore 1985). As the elm decline occurred first in southern Europe, where it was preceded by a decline in other trees, it could not be due to a general decrease in temperature, as this would have hit the north first. Increasing dryness may have caused the decrease in southern Europe, but in northern Europe elm declined equally in the west as in the east, despite the latter being more susceptible to drought (Huntley and Birks 1983). There is also some evidence from the minerals in lake sediments that rainfall increased, at least in the west of Britain, from about 5000 BP, rather than decreased (Mackereth 1965b).

The natural deterioration of soils in marginal areas, especially uplands may have contributed to the elm decline in some areas. Elm is assumed to require fertile, base-rich soils, and would be effected by a loss of fertility, though *U. glabra* can occur on poor, partially leached soils even at the limits of its range (Huntley and Birks 1983). However, a number of sites have two or more elm declines, and regeneration of elms would be impossible if the soil deterioration was sufficiently advanced to cause the first decline. Also climatic and soil deterioration would have effected trees in marginal habitats, and at the limit of their range first, while those in favourable areas would be unlikely to be affected (Rackham 1986). Elm recovery after the decline is related to some extent to soil fertility, at least in Lake District (Pennington 1965), but this may be relevant only to areas marginal for elm growth, and does little to explain the main phenomenon.

4.4.2.2 Disease

Disease has gained popularity as an explanation due to the recent Dutch elm disease epidemic. Perry and Moore (1987) have carried out a palynological study of the recent epidemic suggesting that the pollen changes produced by this are similar to those appearing at the elm decline. Garbett (1981) attempted, unsuccessfully, to demonstrate the presence of standing dead trees in the Holocene forest by detecting increases in ivy pollen. However, if ivy was concentrated at the fringes of the forest as Groenman-van Waateringe (1983) suggests, its colonisation of a tree in the interior, before that tree decayed or fell over, seems unlikely.

The main advantage of the disease theory was its ability to explain the rapidity and synchronicity of the elm decline, previously assumed to be important. The supposed rate of spread of the elm decline in northern Europe was c.4km per year, a rate which the present epidemic has achieved (Huntley and Birks 1983). Girling (1988) considers that the

forested environment of the early Neolithic would have been much less conducive to the spread of the disease than the open environment today. She argues that cool woodland shade hinders both the fungus that causes the disease, and beetle that carries it, though the warmer summers at the end of the Atlantic may have helped the expansion of the beetle population. The rapid spread of the recent disease must also be partly attributed to the existence of motorised timber haulage (Tipping pers. comm.).

Arguments against the theory are based on a lack of evidence for Dutch elm disease in Britain before recent times. The disease is caused by a fungus, *Ceratocystis ulmi*, which is dispersed by an elm bark beetle, *Scolytus scolytus*. The carrier beetle, *S. scolytus*, has now been identified in a pre-elm decline context on Hampstead Heath (Girling and Greig 1985), but the presence of the carrier does not necessarily demonstrate the presence of the fungus (Maloney 1984). The spores of *C. ulmi* itself are hard to isolate because they are not very resistant to decay or the acetolysis process carried out in pollen analysis (Groenman-van Waateringe 1983). Also spores need to be grown to be sure of their identification, and it is probable that the spores of *C. ulmi* are not viable after 5000 years (Moore 1985). Despite some claims that there is no evidence for Dutch elm disease in Britain before this century (Moore 1985), Rackham (1986) has found evidence in historical documents and distinctive staining in the rings of trees that have survived previous attacks, that there were several earlier epidemics at the start of this century and throughout last century. The pattern of multiple elm declines represented by the data base presented here may reflect the regular recurrences of elm disease suggested by Rackham.

Most elm species reproduce almost entirely by vegetative propagation. This results in many genetically identical plants which are specially liable to succumb to new epidemics. Elm clones are rarely killed by modern elm disease, and sprout up from the roots, this could explain the regeneration of elm in diagrams where human activity seem slight. However, wych elm reproduces mainly from seedlings, and has not been so severely affected by recent epidemics of elm disease (Rackham 1986). This species probably for a significant proportion of the elms in Neolithic Britain, especially in more northerly areas, making a nationwide epidemic less likely. Unfortunately elm pollen is difficult to identify to species, and the distribution of the various species are unknown.

The main weakness of the elm disease hypothesis is its inability to explain the decline of other tree species at the elm decline (Moore 1985). If the decline of other trees is attributed to human forest clearing activity, it might suggest that elm declines occurring at the same time and place were also related to this in some way. Rackham (1986) has suggested that as elms grow faster after pollarding, they would be more liable to develop

disease. He also says that elms in clearings are more exposed to attack by beetles than those in the Wildwood, so human activity might have provided the conditions for an epidemic to get out of hand. It seems unlikely that an elm disease would have spread so quickly to Ireland without the movement of people playing some part (Molloy and O'Connell 1987).

4.4.2.3 Anthropogenic

A brief survey of the literature (see table 3.1) demonstrates that the majority of elm declines are reported to be associated with an increase in herbaceous pollen, and only at a very few sites is the absence of this increase specifically noted. The first appearance or a clear peak of *Plantago lanceolata* is mentioned fairly frequently, and occasionally cereal-type pollen is present. The elm decline is also often associated with a decline in other tree pollen. This association of the elm decline with an increase in herbaceous species, a decline in other trees, and often the first appearance of cereal pollen and arable indicators suggest that human activity is involved. Pennington (1975) demonstrated a correlation between the density of human occupation, and more pronounced, long term declines in elm in the Lake District. Early farmers may have recognised that elms grew on the best soil, and felled them selectively in order to create fields. This assumes that elms grew in pure stands, which cannot be demonstrated. Changes in other tree pollen which occurs at the elm decline on some sites implies that clearance need not always have been so selective (Smith 1970). However, the elm decline at some sites is associated with few clearance indicators, and changes in other arboreal pollen occur later. Occasionally this can be proved to be an artefact of percentage pollen diagrams; at Blea Tarn, Cumbria, the decline of other trees at the elm decline were only seen in an absolute diagram (Pennington 1975). Other evidence from the same area does suggest a real division between general clearance, and the elm decline. In the Lake District Pennington (1975) identified declines in birch and pine pollen at the elm decline. She assumes that elm would have grown in the valley bottoms while birch and pine would be more common on the higher slopes. If these did grow in separate areas it could suggest elm would be unaffected by clearance of birch and pine, and that its decline was related to different factors.

Groenman-van Waateringe (1983) emphasises the deceptive nature of the pollen record, which is often influenced by pollen dispersal rather than vegetation composition. The increased representation of agriculture in the pollen record at this time does not necessarily indicate its actual introduction or intensification. Elusive, but convincing, evidence exists for pre-elm decline agriculture, but small clearings in a dense forest are

unlikely to be represented on most diagrams. A rapid loss of elms through disease, possibly encouraged by human activity, would open up the forest especially around settlements, located on the same rich soils on which elms grow. This would result in the distribution of agricultural pollen over greater distances, and increase its representation in pollen diagrams without any actual increase in agricultural activity.

Fodder collection

The most common anthropogenic explanation for the elm decline is that elm was selectively pollarded to provide cattle fodder. A decline in elm pollen does not necessarily imply a decrease in trees. Pollarding would prevent flowering rather than reducing the number of elm trees. Garbett (1981) has produced detailed pollen evidence, from Ellerside Moss, which he interpreted as representing this process. Fluctuations in oak and lime, as well as elm, are interpreted as indiscriminate pollarding, followed by concentration on elm alone, eventually leading to over exploitation, and clearance of elm. There is ethnographical evidence for the severe effect of pollarding on elms e.g. in the Indian Himalayas, and parts of the Alps (Garbett 1981, Rackham 1986). This method of forest management still persists in many parts of Europe from Spain to Sweden (Moore 1985).

Pollarding cannot be separated from tree felling in the pollen record, and some of the loss of elm pollen production could be due to the clearance of fertile land on which base demanding elms may be concentrated. However, to reduce the pollen production so significantly would require large areas being cleared, and clearance indicators are often poorly represented at the elm decline. Most elm declines are associated with some increase in non-arboreal pollen, but this is often small, and best explained by the canopy being open for only short periods at a time. Lopped trees rapidly regenerate, but it takes a considerable time for forest tree pollen production to recommence after clearance activity. Cattle foraging for themselves also have a destructive effect on woodland, and selectively stripping elm bark (AG Smith 1975). At West Heath the decline in tree obligate beetles, and the appearance of dung beetles at the elm decline suggest an opening of the forest that was use for the grazing of cattle (Girling 1988). Ring barking to kill the tree, and encourage growth of shoots from the base may also have been practiced as this would aid both fodder collection and browsing, and reduce elm pollen in a similar way to pollarding (Huntley and Birks 1983).

Some writers have questioned anthropogenic explanations because of the huge amount of work represented by the elm decline. Rackham (quoted in Rowley-Conwy 1982) claims the labour required demands that the population of Neolithic Britain was 10 times the present estimates. It also implies a sudden intensive concentration on fodder collection

across the country when there was considerable regional variation in other agricultural techniques and priorities. Rowley-Conwy (1982) indulges in complex calculations of the number of cattle the British forest could support, and the adult human population needed to reduce elm flowering by half. He concludes that "*the theories of an anthropogenic cause of the elm decline are ruled out by the scale of the operations they demand*" (p206). However, such generalised calculations of rough estimates are easily challenged. They are based on several false assumptions, the first that elm forms one eighth of forest trees through out Britain. This is no doubt true for southern England, but large areas of Scotland had few or no elms. Also the proportion of elms would be lower in upland areas of England and Wales. Secondly it can hardly be pretended that the population of Britain is known for the early Neolithic. Large areas of the country lack research, and sites have been lost under alluvium, cities or the sea. Many known sites have not been adequately dated, and their relative position within the Neolithic is only assumed. An increase of tenfold on present estimates, therefore, may not be so surprising. In comparison Huntley and Birks (1983) calculate a density of 1 person per km² would be enough to account for the elm decline, a density which by comparison to simple modern societies is completely "*plausible for Neolithic Europe*" (p415).

Most importantly calculations related to the elm decline are based on the assumption that the elm decline occurred all over Britain in about 200 years. That would indeed have represented an excessive amount of labour, and an extremely elm-centred economy. The dates for the elm decline clearly need more investigation to determine whether declines any patterning in the dates can be seen. If this activity is spread over a millennium during a time when tree loss was also occurring due to clearance for fields then an anthropological cause for the elm decline seems much more reasonable. Less labour would be demanded per generation, and as the elm decline occurs at different times, and lasts for varying durations it appears less of a uniform aspect of the economy.

Rowley-Conwy (1982) is also concerned about the fodder collection theory because the cattle may not have needed large quantities of winter fodder. Smith (1975) states that cattle can survive well over winter in young temperate woodland, implying that while forest management may be necessary fodder collection would not. Evans (1975) also points out that as Neolithic cattle were not bred as dairy cattle they could live on a diet apparently inadequate for modern cattle. This assumption is open to question, as claims for Neolithic dairying have been made (Legge 1981).

There are reasons for stalling cattle over winter even when they could forage for themselves. If cattle are kept in pens over winter, domestic bulls can service the cows, and

interbreeding with wild bulls can be prevented. The size difference between early domestic and wild cattle suggests the populations were efficiently separated. Cattle have no specific breeding season so the farmer can control when the young are born. A spring mating will result in births at the end of winter and beginning of spring (Greig 1988). Carefully timed mating could depend on keeping bulls stalled all year, as well as stalling the cows over winter (Reynolds 1987). Cows need a fat rich diet when lactating, and the natural winter forage would have to be supplemented. This extra work would be rewarded by milk and still-born calves at a time when food, in particular fat, is in short supply. The convenient accumulation of manure may also have been an important benefit of stalled cattle (Gregg 1988). Fleming (1972) considers herds of 20-30 cattle per 1km² of forest probable in the Neolithic, implying considerable modification of the vegetation by browsing and human activity.

There is a small, but varied body of information supporting the use of leaf fodder in Neolithic Britain and Europe. At the Weier lake village, north-east Switzerland leaf-hay residues, including small branches, twigs and leaf fragments, were found in structures interpreted as barns (Robinson and Rasmussen 1989). Immature lime fruits found on a Neolithic site in the Blackwater Estuary, Essex, may represent the collection of the leaves of this species for fodder (Murphy 1989). Experiments at Butser Experimental Farm have shown leaf fodder to be a very good winter feed for livestock, preferred to hay by goats and prehistoric breeds of sheep. Elm and ash are mentioned as the best fodder species (Reynolds 1987). Hazel may have been used in a similar way in the Somerset Levels, collected as part of a coppicing regime (Rackham 1986). Historical records indicate that lime and ash were used as cattle fodder as well as elm, with ash being preferred (Aaby 1986). On some British sites ash increases at the elm decline, with at least one exception at Pawlaw Mire (Sturludottir and Turner 1985). This does not mean that ash was not exploited. After pruning ash will flower again in 2-3 years whereas lime takes about 4 years to recover, and elm takes 7-8. Historical examples of pollarding regimes suggest that a 2-3 year rotation was common, which would enable ash to flower between lopping, but lime and elm would have no chance to recover fully. The more open canopy would also favour ash, and increase its flowering between pollarding (Aaby 1986). Therefore fodder collection could have affected several tree species, with elm being less able to recover, and their pollen production most severely effected. The regeneration often seen after the first elm decline, and subsequent declines and recoveries in a region would suggest the area exploited for fodder did not remain constant, though movement would seem to be long term, rather than the short term moves of nomadic herders. It seems probable that on the scale of may be half a millennium some social or economic force would cause localised movement of settlements, or shifts in landuse.

I would suggest that the exploitation of elms for cattle fodder best fits all the available evidence, and while it may not explain all elm declines, probably accounts for most. This is not to claim that the cause of the elm decline has been proved in any way, as it relies on little more than circumstantial evidence. However, it is worth considering because this data could fill a crucial gap in our understanding of the beginnings of agriculture. Some relationship between distinctly Neolithic activity and the elm decline is certainly suggested by the radiocarbon dates. Both start fairly suddenly around 3500 bc, and occur fairly evenly after that date. The elm decline dates possibly start slightly earlier than the archaeological ones suggesting perhaps the occurrence in many areas of Neolithic economic activity about 200 years before the appearance of a fully Neolithic material culture. It is equally probable that this discrepancy is caused by the type of materials dated. The elm decline dates are all on peat or lake muds, while the archaeological dates are on a variety of materials. Though the potential errors associated with the archaeological dates are considerable, those on the environmental dates are probably larger. The data presented here could suggest that over all the environmental dates are too old, being contaminated by reworked material and the upwards movement of humic acid. Either explanation would fit the evidence, but personally I mistrust the environmental dates, and would suggest that a direct comparison between these and the archaeological dates is not possible.

4.4.2.4 Regional analysis

A direct comparison between regional elm decline and archaeological dates is difficult because of the difference in site distribution. It has already been mentioned that the bulk of elm declines in most regions start about 3500 bc, slightly earlier than the main range of archaeological Neolithic dates. The Pennines are the one exception to this as the bulk of the dates here start c.3250 bc, much the same as the archaeological dates. There are some significantly earlier dates from this area which relate well to dates from other regions that extend well before 3500 bc. The errors related to the dating of peat could be account for the differences between palynological and archaeological dates. Considering these problems the two events might be considered as starting simultaneously in most areas. It may be significant that elm decline dates from southern Scandinavia are also generally slightly earlier than the earliest Neolithic dates (Larsson 1985). It is difficult to determine whether this indicates that errors on peat dates tend to make them earlier than comparable archaeological ones, or whether the elm decline is not in fact closely related to the first recognisable Neolithic activity in an area.

Upper Teesdale, the Pennines, the Lake District, and the south-east of England all have occasional dates which extend significantly before 3500 bc. In the first two cases these form distinct elm decline episodes much earlier than other elm declines in these, and other areas. In the last two regions the early dates cannot be separated from the later ones with which they overlap considerably.

It has been claimed for Teesdale that the elm decline occurred earlier on the coast, and represents a movement of Neolithic activity inland (^{Chambers 1978}). However, there are two elm declines at the site of Valley Bog, the second is later than elm declines on the coast, but the first is dated to 3995 ± 50 bc. The usual convention is to define the elm decline as the first, major drop in elm, and it is rather inconsistent to use the final decrease if this fits a convenient hypothesis.

Early clearance phases associated with elm declines have been identified at Pennine and Teesdale sites at a date normally considered to be Mesolithic, i.e. around 4000 bc. The later dates for the majority of elm declines on the Pennines suggests a comparatively late adoption of Neolithic practices in this area. This region has been fairly well studied, but few early Neolithic sites have been reported. A pre-elm decline cereal pollen grain from Soyland Moor on the Pennines, which has a date very similar to the elm declines at Rishworth Moor and Valley Bog could suggest arable farming at this period, but problems with the site of Soyland Moor and early cereal-type pollen grains are discussed below. Though the dates from the Lake District seem more acceptable as Neolithic activity they are much earlier than any dated Neolithic sites in the area. Also the first elm decline at Williamson's Moss in Cumbria is at the same level as supposedly Mesolithic timber structures embedded in the peat.

4.5 Cereal pollen

As the possible relationship between the elm decline and early agriculture cannot be established, a less ambiguous indicator is necessary to detect the earliest agriculture. Cereal pollen should be a good indicator of Neolithic-type activity. No cereal species are native to Britain, so their presence should indicate a knowledge of farming techniques. This is true as long as the cereal pollen grains can be accurately identified, and contamination can be ruled out. The identification of *Cerealia* pollen grains is problematic, as they are much like other grass pollen grains, apart from being rather larger. Grains measured at over 37 micrometers, in a non-swelling medium, are generally assumed to be cereals, but the pollen grain size range of many grass species overlaps that of the cereals. Identification is more secure if the pore and annulus size is also measured. In cereals the pore is larger, and the annulus thicker than in other grasses. However, fossil grains are often crumpled making the study of pore and annulus difficult (Edwards 1989a).

Identification to genus is often possible if the exine sculpturing is examined. However, this is time consuming, and only carried out if the analyst is particularly interested in early cereals. Unfortunately, wild grasses of *Hordeum* (barley) type are native to Britain e.g. couch-grass (*Agropyron*), lyme grass (*Leymus arenarius*), and marram grass (*Ammophila arenaria*) (Andersen 1988). The last two can be a source of confusion on the coast. Coastal sites with evidence for early cereal-type pollen, such as Aros Moss (Edwards 1989), Machrie Moor (NR424), and Rims Moor (SY1) may be affected by this. O'Connell has demonstrated that large cereal-type pollen identified on one site was in fact pollen from wild grass (*Glyceria*) (quoted in Woodman 1992 p302). It is, therefore, very hard to prove that a pollen grain is in fact derived from the *Cerealia*, and is not a native grass. Kinnes (1988) suggests that climatic amelioration in the late Atlantic might favour grass growth, and lead to the production of exceptionally large pollen grains, though he does not discuss whether climate can cause this physiological change in grasses.

Edwards and Hiron (1984) argue that cereal-type pollen grains only appear in the pollen record just before the elm decline, but Bush and Flenley (1987) identify 7 large pollen grains, dated to 9000 BP, as *Avena*/*Hordeum* type. Perhaps if all large grass grains were reported, their distribution throughout the postglacial may prove to be more even. The use of annulus diameter and exine sculpturing as identification criteria, and the publication of photographs of the grains would make claims more reliable. Kinnes (1988)

24. Codes following site names in this chapter refer to appendix III which includes a bibliography and locational information.

argues against the reliance on palynology alone to demonstrate the presence of cereals, macrofossils being more securely identifiable. However, locating early cereal macrofossils demands excavating *at* very early Neolithic sites, which happen to have good preservation conditions; a situation likely to occur only by chance. At least it is possible to deliberately search for early cereal pollen.

Problems of contamination must also be considered. The process of sampling the sediment may cause some contamination especially if the deposit is not very firm. Objects as small as pollen grains can move fairly easily within a deposit. In peat root action, cracking of the sediment due to drying or frost and water movement can transport pollen through the deposit. In lake sediments there is considerable disturbance of the surface deposits by water movement and bioturbation; pollen may thus be well mixed before it is buried. Significant contamination can be caused by the use of borers, with Hiller borers being particularly bad, because they rotate during descent. Early alder peaks have been attributed to this contamination (Shore 1988), and it seems probable that a few grains of cereal and weed pollen might be introduced to earlier levels by this effect. On the larger scale of general vegetation change these movements are not so important, but when the presence of a single cereal grain before the elm decline is used to suggest early agriculture, then these are important considerations.

Very few cores have a radiocarbon date on the level of the first cereal-type pollen, the elm decline being frequently used as a dating horizon, though this is clearly no longer justified. The dates that do exist are often the earliest evidence for Neolithic-type activity in an area. As they are unsupported by any other evidence, these few early cereal-type pollen grains must be treated with some suspicion, at least until more early dates are available.

Claims for pre-elm decline cereal pollen are more convincing when associated with the appearance of other clearance indicators, usually including *Plantago lanceolata*, and sometimes *Artemisia*. This perhaps suggests that some genuine human activity was occurring, and it makes contamination from higher layers less likely, as the pollen assemblage probably would not remain together. Of the earliest cereal pollen claims, Cashelkeelty in Ireland (Lynch 1981) is associated with clearance indicators. This is also the case at Soyland Moor, South Yorkshire (SD725), but at this site beech pollen, which should not have been present at such an early date, was found at the same level. Contamination might, therefore, be suspected.

25. See footnote 24 p156.

Other effects can be produced by woodland clearance which alter pollen influx to the site. Clearance could lead to a higher representation of large grass pollen grains at a sample site, as fewer grains would be filtered from the air by the trees. This could result in an increased deposition either of large wild pollen grains or cereal pollen already present in the area. In the latter case the presence of the cereal pollen need not represent the first cereals grown in an area. A larger open area may also increase the regional component on a site, increasing the chance of long distance transport bringing Continental cereal pollen to a site. Large grains generally do not travel far, but if they chance to catch an updraft they can be carried for great distances in the upper atmosphere (Edwards 1982).

Alternatively, an absence of cereal pollen cannot be used to demonstrate an absence of agriculture. Reynolds (1991) had no success in trapping pollen from cereals, and was unable to detect it more than 50cm from individual plants. Because the pollen of cereals is rare it can easily be over looked if a relatively low pollen count is taken. Rapid scanning of slides from close sampled levels round the elm decline can reveal the presence of cereal pollen in areas where previous pollen diagrams have failed to register it (McIntosh 1986).

Cereal-type pollen was dated at Soyland Moor (appendix III, SD7) to:-

5820 \pm 85 BP (3870 bc) Q-2394

Some possible cereal pollen grains are shown in the diagram for Widdybank Moss in Upper Teesdale (NY16) just before the elm decline, though their significance is not discussed by the authors. As this site is very close to Valley Bog (NY14) where the first elm decline is dated between:-

5950 \pm 60 BP (4000 bc) SRR-92

5945 \pm 50 BP (3995 bc) SRR-93

this may also represent a very early occurrence of cereal pollen. Though both areas have early elm declines, field walking has revealed very few Neolithic artefacts, but numerous Mesolithic ones.

At North Mains, Strathallan^a (NN1), cereal type pollen grains are regularly present onwards from

5680 \pm 70 BP (3730 bc) GU-1724

Hulme and Shirriffs (1985) place the elm decline 15cm further up the diagram, but the diagram can be interpreted to suggest a long elm decline, beginning close to the level containing the cereal-type pollen (Tipping pers. comm.). In the South cereal-type pollen is present at Winnall Moors, near Winchester (SU4), and dated to:

5630 \pm 90BP (3680 bc) HAR-4342

However, this is associated with a distinct elm decline, and evidence of extensive woodland clearance (Waton 1982).

In several cases the cereal pollen appears just before the elm decline. At Machrie Moor, Arran, (NR4) the elm decline is dated to

4740 \pm 85 BP (2790 bc) GU-1346

This gives the cereal pollen an interpolated date of 5375 BP (3425 bc). Rhoin's Farm (McIntosh 1986), on the mainland opposite Machrie Moor, also has pre-elm decline pollen possibly of a similar date. An interpolated date of 5350 BP (3400 bc) is quoted for pre-elm decline cereal type pollen from Rims Moor, Dorset (SY1). The dates for early cereal-type pollen in these cases are a little earlier than the majority of Neolithic dates from archaeological sites. Where interpolated dates are quoted the error associated with these dates can be assumed to be fairly large, more than that on the radiocarbon dates used to calculate it. The cereal pollen could, therefore, be present at a comfortably Neolithic date, and imply only that the activity causing the elm decline occurred later than the introduction of cereals.

It is tempting to suggest that these dates represent sporadic cereal cultivation from as early as 4000 bc, but factors affecting the reliability of radiocarbon dates must also be remembered here. Where there are too few dates on a core, anomalous dates cannot be identified, unless they fall completely out of sequence with the other dates. As erosion is often seen in relation to forest clearance, the evidence for clearance and pollen could be genuine, but erosion of old carbon out of the soil could result in an artificially early date. Dates on pollen cores can use samples of about 10cm thickness, which could represent the accumulation of material over several hundred years. Radiocarbon dates on pollen profiles are too unreliable to base any theories on a small number of very early dated cereal-type pollen. Many more well dated, and securely identified cereal pollen grains are needed before the significance of the present data can be judged.

Groenman-van Waateringe (1983) lists 11 sites in Ireland with some evidence for pre-elm decline agriculture. At three of these she believes that agriculture is "certainly"

represented, and on 5 more it is "highly probable". Edwards and Hirons (1984) list 3 further sites in Britain. Edwards (1989a) lists 22 sites from Britain and Ireland with cereal-type pollen. At Rhoins Farm, Aros Moss, and Moorlands, Machrie Moor the cereal pollen was found only after an intensive search specifically for this (McIntosh 1986). The suggestion is that cereal pollen could be found on more sites if methods for optimising its discovery were used. Most important seemed to be rapid scanning of the pollen slides looking specifically for cereal grains, this greatly increases the number of grains inspected, and makes the discovery of rare grains such as cereals more likely (Edwards 1989a).

Pre-elm decline cereal-type pollen is, therefore, moderately well attested, and while the elm decline may be an indication of Neolithic activity, it is not necessarily the earliest form of this. This has been used by Groenman-van Waateringe (1983) to argue against the importance of human activity as a factor in the elm decline. An alternative view is possible if the elm decline is taken to represent cattle husbandry, and cereal pollen to represent arable farming. The existence of pre-elm decline cereal pollen suggests that arable agriculture may have been initiated before animal husbandry, or at least the selective exploitation of elm for fodder. It is possible that one or both of these practices began before the development of a fully Neolithic culture.

The early dates on elm declines and cereal-type pollen from the Pennines and Upper Teesdale, where early Neolithic activity is poorly attested might represent the keeping of stalled cattle, and possibly some arable farming by people with traditionally Mesolithic material cultures. Similar activity recorded in southern England comes from areas with numerous early Neolithic sites, some with early dates. However, as discussed above (p¹²⁰⁻¹), it is possible to question whether the radiocarbon dates are capable of providing a chronology precise enough to allow comparisons between vegetational and archaeological events. Existing radiocarbon dates on early cereal-type pollen are few, and widely scattered, and could easily be anomalous.

Environmental dates, therefore, suggest an intensification of agricultural activity at about 3500 bc, possibly as a continuation of a long history of clearance activity. Unfortunately, evidence for early experiments in arable agriculture, or intensive management of wild game is sparse and controversial. Palaeoenvironmental evidence can demonstrate that early Neolithic agriculture was well established, and of some complexity. It can also indicate the existence of numerous Mesolithic clearings, probably related to woodland management. What it cannot do is to demonstrate a relation between these activities. The environmental data places the earliest recognisable, and secure evidence for agriculture at much the date as the archaeological evidence does. However, it is probable

that environmental techniques are no more suited to detecting the earliest farming than are archaeological ones. There are too many possible sources of contamination and confusion for occasional early experiments in agriculture to be recognised as such, if these did exist.

CHAPTER 5: A REGIONAL STUDY OF LATE MESOLITHIC AND EARLY NEOLITHIC SITE DISTRIBUTION IN BRITAIN.

Existing radiocarbon dates appear inadequate to either ~~be~~ demonstrated or rejected the contemporaneity of late Mesolithic and early Neolithic cultures. The problems of relating the pollen evidence to material cultures, as well as problems of interpreting just what activities are being represented in the pollen record, make it difficult to determine the processes involved in the Transition. Other approaches are clearly necessary to help illuminate this elusive period. In this chapter the archaeological record itself will be discussed; in particular the nature of the information to be gained from the spatial distribution of sites and findspots.

The spatial patterning of sites or individual objects forms the basis of many models about the nature of late Mesolithic and early Neolithic societies, and the relationship between them. Any discussions about population distribution (Jacobi 1978), settlement patterns (Gaffney *et al* 1985), settlement hierarchy (Bradley 1982), and the existence and nature of exchange networks (Care 1979, 1982), amongst a great many other topics, rely on the interpretation of spatial patterning of findspots.

This chapter will largely be concerned with the degree to which the ancient human landscape can be reconstructed, and its ability to provide information about the processes involved in the Transition. The attitude of authors to the reliability of archaeological site distributions varies considerably. Most prehistorians, who have little choice but to work with this data, tend to acknowledge the biases, but believe that the data can be interpreted. Others, particularly those working in historic periods, have a more pessimistic view of prehistoric site distribution patterns. Rouse (1972) considers that only a remnant of ancient patterns can be recovered archaeologically, but interpretation of those remnants is possible. Taylor (1972) is much more pessimistic, and believes that "*the recovery of the pattern of settlement of pre-Saxon society in Britain is something that archaeologists cannot achieve*" (p109). Though Groube (1977) calls this absurd, the evidence would largely seem to support Taylor's statement, as discussed below.

The distribution patterns that have survived into the present are a remnant of the original pattern formed by the cultural and economic activities of past populations (Rouse 1972). To recognise the completeness of a site distribution pattern, it must be possible to construct an expected distribution, with which the surviving remnant can be compared. For prehistoric periods the only data that can be used to model an expected distribution is the

very same that forms the surviving distribution. While models based on comparative anthropology may be constructed, their relevance to a certain period of prehistory can only be confirmed by comparison to the surviving distribution pattern. There can be no independent expected distribution against which to test the surviving site distribution, so the completeness of this cannot be judged (Clarke 1973). Attempts to predict even how many sites may exist today, yet to be found, are likely to be unsuccessful beyond certain very limited circumstances (Fojut and Fraser 1981, quoted in Fraser 1983).

However, if archaeologists demanded only reliable data their discipline would not exist, so prehistoric archaeologists must work with the data available. Site distribution patterns, like other archaeological groupings should be treated as "*hypothetical entities*" (Clarke 1973 p14), but some progress may be possible in judging their probable completeness. It is generally assumed that by studying the effect of post-depositional and research factors, patterns not explained by these may represent the ancient site distribution. It may be possible, not to reconstruct the original ancient settlement pattern, but to assess the degree to which the surviving pattern is distorted, and perhaps to isolate a few original trends. This approach depends largely on the ability to list all possible biases, and assess their significance in individual cases.

5.1 Taphonomic factors

5.1.1 Survival of evidence

"By chance accident, odd residues of past human activities have survived into the present; by further chance accident archaeologists have come across some of these residues" (Leach 1977 p167). This summarises the essence of site distributions in archaeology, though I do not believe that Leach meant to suggest mathematical randomness by his use of the term *"chance accident"*. If this were so the uncertainties of archaeological evidence might be amenable to statistical analysis. In fact many factors influence the chances of discovery, these are largely unquantifiable, and destroy any true randomness in archaeological discovery. Known Mesolithic and Neolithic sites represent a sample of those few sites that have survived five millennia. The traces of original site distribution that can be expected are slight and incomplete, and are made even more so by patchy and often biased research.

The critical concept in this discussion is taphonomy. Taphonomic processes are numerous and varied, and most will impose artificial spatial patterning on the archaeological record. This subject has been much discussed, so the consideration of taphonomic factors will be here kept concise. Appendix VI contains specific examples of the factors discussed, in relation to Mesolithic and Neolithic archaeology in Great Britain.

The majority of early sites are represented by surface finds, and conditions favouring these will result in an over-representation of sites. However, the same factors that can reveal sites can also destroy them. The regions where most destruction of sites have occurred are the ones that seem to have been most favourable to occupation, because it is later activity that causes much of the destruction of earlier sites. Surviving sites may be marginal, not only today, but also when they were in use, and therefore perhaps not typical of the culture in general (Taylor 1972). It is hard to know whether barrows and cairns are located on marginal land because they have not survived elsewhere, or because they were originally only constructed there (Stevenson 1975). Aerial photography has revealed a greater extent of Medieval farming in areas, such as the Midlands, than was once thought, and this continued landuse seems likely to be largely responsible for the scarcity of early monuments in these areas (Hartley 1989, Gibson 1989). Pickering (1989) considers that standing Neolithic monuments are probably concentrated on poorer land purely because these soils were too poor for later cultivation.

The scale of a site is important to its survival; deep ditches will survive as cropmarks even after extensive ploughing, whereas shallow ditches would be completely eradicated. Large cairns may survive in arable areas because it is easier to plough round them than remove them, but small cairns are easily cleared (Stevenson 1975). Even when barrows survive as islands in a ploughed field, their context, and even their surrounding ditches, can be lost to ploughing (Richards 1990).

Submergence and erosion of the coast has caused a considerable loss of sites in many areas. Tectonic down-warping is significant on the eastern coast of England, but elsewhere erosion causes important coastal loss. This varies dramatically with the resistance of the bedrock. While the coast of England and Wales has suffered varying degrees of erosion parts of the coast of Scotland have risen above sea level. The weight of ice over Scotland during the last glacial depressed the land surface, which began to rebound once the ice melted. As this isostatic rebound has outstripped the eustatic sea rise, beaches formed in the past have been lifted above sea level (Donner 1970). There are well developed raised beach deposits along the Carse of Forth, and much of the west coast (Jardine and Morrison 1976, Kemp 1976, Morrison 1969). Orkney and the Outer Hebrides were beyond the limit of the main ice cap, and have not undergone isostatic rebound. The post-glacial sea level rise has led to submergence and coastal erosion on these islands (Crawford and Switsur 1977, Ritchie 1979).

The material out of which buildings are constructed is obviously of great importance. While most domestic structures were built of timber, and are preserved only as enigmatic post holes in most cases, monumental structures of stone are bound to be better preserved and more prominent. Orkney is of particular archaeological interest, not only because of the impressive tombs, but also because the local stone type has allowed ordinary domestic structures to be built of resilient stone. Here architectural details rarely preserved even in waterlogged sites can be seen, because of stone construction. Some of these sites may also be preserved and protected from stone robbing by burial under sand (Hunt 1987).

5.1.2 Discovery of evidence

While arable farming can cause the destruction of upstanding monuments, it is important for the identification of artefact scatters. Ploughing truncates and destroys archaeological features, but it also brings to the surface artefacts that are the only means of identifying most, small domestic sites (Holgate 1988). The distribution of stone axes is heavily influenced by present landuse; being largely restricted to arable farmland. Few are

found on uplands, probably due as much to the lack of favourable discovery conditions, as to the use of the axes in antiquity. However, axes are not uniformly scattered over regions of ploughland, suggesting the influence of some genuine distribution factors (Annable 1987).

Alluvial and colluvial deposits are significant in many valleys, as they may be assumed to mask early sites, and distort the distribution pattern. The importance of this factor is highly variable, and some valley-side distributions, such as that in the Vale of the White Horse, Oxfordshire (Tingle 1987), do seem to be genuine.

On acid uplands peat may protect and hide sites. Both monumental and domestic sites can be protected by deep peat, and the absence of destructive activities on uplands. Domestic sites will only be discovered if burning, erosion, peat cutting or pre-afforestation ploughing occurs. In understanding site distribution patterns the discovery of sites is as important as their survival. Sites masked by peat and vegetation cannot add to the understanding of the distribution pattern, but, at least there is the potential for their future discovery (Stevenson 1975). On the central Pennines are a great many Mesolithic sites preserved under peat, and revealed by erosion. Sites on the lowlands have been destroyed by agriculture, or covered by alluvium, causing an over-representation of the uplands (Jacobi *et al* 1976). Areas of grassland, and woodland are as unlikely to produce surface finds as moorland (Gardiner 1984). Scotland suffers particularly seriously from the masking effects of blanket peat, which covers an unknown number of sites. The peat is generally stable and not eroding, making upland afforestation the only possibility of locating sites (Woodman 1989). The abandonment of farming on the uplands of Scotland has allowed large number of cairns to survive, but the scarcity of arable land means knowledge of site distribution, through lithic scatters is very slight.

The unstable environment of sand-dunes is very favourable towards revealing artefact scatters, mobile sand covering and protecting sites, and later further movement revealing them. Sandy soils often have open vegetation, and are disturbed by rabbits, which greatly increases the chance of sites being revealed. However, Healy (1984) argues that despite the good conditions and intensive field walking, the quantity of material could not have been found in locations, such as the Brecklands, if there had not been considerable activity there in the past, suggesting a high recovery rate might reveal something about the past, as well as the survival and discovery conditions of the area. Sandy soils also encourage excavation, and sieving is easier and more successfully applied on these soils, allowing greater recovery of microliths and other small artefacts than in heavier soils (Jacobi 1981).

Where sand forms dynamic dune systems it is less favourable to archaeology. The shifting sand destroys stratigraphic relationships between artefacts and occupation horizons. The masking ability of sand is most clearly seen in the Western Isles of Scotland. The Hebrides, especially the Outer Hebrides, have considerable deposits of machair, shell sand, along the west coasts. The high machair, formed by the mid third millennium bc, masks early sites, and the later erosion of the sand resulted in deflation and the loss of stratigraphy on sites that were subsequently revealed (Crawford and Switsur 1977, Ritchie 1979).

Abundance and scarcity of raw lithic materials can influence the identification of sites by surface scatters. Where natural flint sources are widely distributed worked flint is likely to be ubiquitous, and clusters of finds representing sites are hard to define. It seems unlikely that fieldwalking can pin-point settlements in these areas, e.g. the chalklands of Oxfordshire (Tingle 1987). In areas with no natural flint, e.g. the London Clay in East Berkshire, densities as low as 4-5 pieces per hectare may represent a site, making these hard to recognise without intensive fieldwalking (Ford 1987b). Chert, by the archaeological definition, is coarser, less homogeneous and more intractable than flint (Wickham-Jones 1986). Where natural chert is abundant it is often difficult to identify worked from naturally broken pieces, and there may be few artefacts collected. In areas lacking natural chert, even poorly worked pieces are obvious anomalies (Radley 1968). Worked quartz is even harder to identify, and is rarely collected during field walking in Britain.

The early Neolithic seems to suffer particularly from problems in detection and identification of flint scatters. In some regions, such as south-east England, few early Neolithic flint scatters have been identified, despite numerous monuments of the period. Often late Neolithic, early Bronze Age, and even late Mesolithic sites, are much more numerous than early Neolithic scatters. All these periods have a high proportion of artefacts present in the ploughsoil, where they can be identified by fieldwalking. Excavated early Neolithic sites generally, have artefacts concentrated in pits, whereas artefacts of other periods tend to be scattered on the old land surface. These latter sites may be more disturbed and weathered, but they are detectable, unlike the early Neolithic material which is often below the reach of the plough, and not incorporated into the plough soil (Healy 1987). The effect is more pronounced where the topsoil is deep, which may account for the absence of early Neolithic scatters in areas with many monuments, such as Cranborne Chase (Bradley *et al* 1984).

Scatters may also be masked by later, larger sites as appears to have occurred on the uplands round North Stoke, Oxfordshire (Ford 1987b). Only a small proportion of the material culture of a society will be preserved in the ploughsoil. Cultures using more stone tools than others will be more archaeologically visible. The composite tools of the late Mesolithic, and the expedient technologies of the late Neolithic, resulted in considerable quantities of stone debris. Groups using more organic than stone tools would be poorly represented, and this may explain the scarcity of early Neolithic scatters in some areas (Ford 1987b).

5.1.2.1 Research

Variation in site density is often due to differential research. The nature of a collector's interest; the location of their home, or in some cases their holiday home; the quality of their field work, and their ability to interest others have very significant affects on sites distribution. The intensity of fieldwork tends to decrease with distance from a collectors home base (Young 1986), and this seems to apply even today when many collectors have cars (Woodman 1978b). The scarcity of sites in Northern Scotland is due not only to natural factors of masking and destruction, but also to the present low population density. The uplands are relatively remote from both major museums and the homes of local collectors, so field work is patchy. While a large number of sites must have been lost under Edinburgh and Glasgow the higher population density gives a greater possibility of sites being discovered (Hunt 1987, Woodman 1989).

Though eroding peat on uplands has as much potential for revealing sites as ploughed land, access to the latter is much easier, being in lowlands and near roads (Young 1986). Lowland sites therefore tend to be over represented, the Pennines being a notable exception. However, once an area is known for being prolific in flints, it tends to be concentrated on to the exclusion of elsewhere. Scatters may be present on the lowlands of Lancashire and Yorkshire despite the alluvium, but they have never been systematically searched (Keighley 1981). Though the Pennines have a large number of known sites, much of the work was done by amateurs last century: in consequence many collections were unsystematically collected, and poorly recorded (Keighley 1981, Leach 1951). The problems of unmethodical and biased collecting, and poor recording of surface finds and excavations can seriously reduce the amount of information for an area which might initially appear well researched (Saville 1984a, Jacobi 1980, Gardiner 1987).

Gardiner (1984 and 1987) has studied in detail the Neolithic collections from museums in central southern England, and has considered the human, as well as physical,

biases in surface collections. The majority are casually collected by amateurs, who tend to concentrate on large and fine pieces, and to overlook small and waste pieces. Finds spots are often very poorly documented. Collectors may be biased towards certain periods, and though they thoroughly walked an area they may have overlooked certain classes of finds. However, surface collections form a vast data base which cannot be ignored. Even heavily biased collections can highlight very productive areas, though the absence of collections cannot be used to demonstrate the absence of occupation in an area. Knowledge about individual collectors allows an assessment of their reliability to be made, and some amateurs can produce evidence equal to that from professionally planned, methodical field survey. Museums, unfortunately, do not always preserve detailed notes and complete, relatively unbiased collections, sometimes considering debitage not to be worthwhile storing.

The interest in early Neolithic surface scatters is itself a fairly recent development. The existence of impressive monuments previously drew attention away from settlements, which are represented only as surface scatters (Holgate 1988). The effect of differential research is often most clearly revealed when imbalances are redressed, and areas that have had little research receive intensive treatment. Often a lack of sites is demonstrated to be illusory when systematic survey are conducted. It is important that variations in the opportunity for discovering sites are recognised in an area, so spatial patterning caused by these factors is not interpreted as ancient settlement patterns. For example, in Northamptonshire the River Nene forms a dividing line between numerous sites to the south and a paucity of archaeological sites to the north. Though this appears initially to be a significant trend in the distribution pattern, it is most probably due to greater activity of local archaeological groups along the river and to the south of it, combined with ironstone mining and urban development that provided the opportunity for sites to be found. The soils are lighter south of the river, but this means that cropmarks are more prominent and so more sites are located rather than an avoidance of heavy soils in antiquity (RCHME 1979b).

Fieldwork can also, tentatively, support gaps in the distribution pattern. Mesolithic finds are rare in the Welsh Marches, largely because of the paucity of field work, but intensive work on the Clun-Clee ridgeway zone produced only 12 microliths, and the few other sites that are known are small and transitory; clearly not base camps (Stanford 1980). The extensive surveys of the Stonehenge Environs Project recovered very few Mesolithic artefacts, perhaps suggesting only an occasional, mobile exploitation of the Wiltshire chalk in this period (Richards 1990). Negative evidence must be treated

cautiously, as it is most likely to be the result of survival and discovery factors, or merely our inability to recognise the full range of material culture of some periods.

Aerial photography can play an important role in identifying ploughed out monuments, often impossible to recognise in any other way. The use of aerial photography has vastly increased the number, and extended the distribution, of known archaeological sites (Pickering 1989). The two causewayed enclosures in Norfolk were recognised in this way: neither produced any surface finds which would have allowed their identification on the ground. Round mounds, which may be early Neolithic, are also identified by aerial photography, revealing the presence of early Neolithic monuments in East Anglia, where they were thought to be lacking (Healy 1984). However, as aerial photography produces good results only on certain soil types and under certain agricultural conditions, other similar sites could exist elsewhere and not be spotted even from the air (Taylor 1972). These conditions continually vary, and *"crop marks are temporary phenomena"* (Hartley 1989 p98). Some sites appear only once or twice due to special conditions and may be visible for less than a day, so even in well surveyed areas many sites will be missed. Aerial photography detects mainly negative features, and sites lacking these will usually be missed (Hartley 1989). Apart from locating ploughed-out shell middens aerial photography is of little use in identifying Mesolithic sites.

Smith and Openshaw (1990) have claimed that the influence of post-depositional processes and research biases are minimised, at least for hunter-gatherer sites, when site distribution is considered at a large scale. They suggest that the presence of one hunter-gatherer site in a 10km square, suggests that the whole square was occupied, because of the highly mobile lifestyle of hunter-gatherers. They claim that this removes biases of differential research and preservation within the square. This is undoubtedly true to some extent, but areas of mountain or blanket bog are considerably larger than this and would still significantly affect the distribution pattern, as would counties that little archaeological activity devoted to this period. Even using 10km squares to indicate site distribution the resulting pattern would be mainly attributable to post-depositional processes.

5.1.3 Dating and artefacts

Once found sites need to be placed in some chronological grouping if the distribution pattern for a period is to be identified. Sites attributed to one period cannot be called contemporary as they may represent a span of up to several thousand years. Determining actual site density or changes of distribution during periods would therefore be difficult even if all surviving sites had been discovered. In this chapter sites have mainly

been dated by the presence of artefacts accepted to belong to certain periods. The late Mesolithic is generally defined (following Jacobi 1976) by the presence of geometric and rod microliths, and seen as starting in the early seventh millennium bc and probably ending during the fourth millennium, though there is disagreement on the degree of overlap with the Neolithic (Bradley 1978, Williams 1989, Whittle 1977, Zvelebil and Rowley-Conwy 1986). The use of microlith typologies to divide the long duration of the late Mesolithic into shorter periods has not been successful, even rod microliths are not necessarily only found at the end of the period (Jacobi *et al* 1976). Microliths are found in later contexts, but they are most easily explained as being residual material in these cases (Whittle 1977). Tranchet axes are commonly assumed to be diagnostically Mesolithic, but Gardiner (1990) presents a fairly convincing argument that their use may have continued into the Neolithic period. She reports that they are found in surface collections associated with only Neolithic material, and some have been recovered from the spoil heaps of a Neolithic flint mine. Many artefact scatters are the result of repeated occupations. It is impossible in this situation to be sure which artefacts are from the same period, unless they have been found in association on excavated sites. As tranchet axes are often poorly stratified their full temporal range may not yet be identified, and their use as indicators of purely Mesolithic activity should, perhaps, be treated with some caution.

The definition of Neolithic is a little more contentious. Some writers, (Bradley 1978, Whittle 1977, Case 1986) propose a pioneering phase of the early Neolithic that is largely archaeologically invisible. Kinnes (1988) points to the variations in what authors include as the early Neolithic as an indicator of the "*confusion of thought and analysis*" (p2) on this subject. As this chapter deals only with material remains, this phase is ignored here, and the early Neolithic is defined by known monuments and artefacts. Darvill (1987) has an early Neolithic dated from 3500 to 2900bc, but this is based on very dubious radiocarbon dates. Most authors have the early Neolithic extending from a little before 3000bc to 2500bc (Piggott 1970, Bradley 1984, Smith 1974, Healy 1984). Bradley and Smith do not include a middle Neolithic, whereas Piggott does, however the artefacts used to define the early Neolithic are agreed. A major social change is often suggested at about 2500bc, expressed in the construction of henges and other large monuments (Laing and Laing 1982, Smith 1974, Spratt 1982). The monuments commonly agreed to fall within the early Neolithic, and therefore which are used here as its definition, include causewayed camps, long barrows, and some megalithic tombs, though the tombs continued being constructed into the late Neolithic (Piggott 1972, Thorpe 1984, Holgate 1988). The flint mines on the South Downs are also early (Whittle 1977, Smith 1974). While some round barrows may be early Neolithic, it is difficult to identify early from late ones (Thorpe 1984), especially where they are unexcavated, so they have been excluded from this study.

Western Neolithic pottery types, both plain and decorated, are dated to this period (Field *et al* 1964, Smith 1974, Holgate 1988); Peterborough and grooved ware mark the late Neolithic, though Spratt (1982) suggests considerable overlap between Peterborough ware and earlier pottery types. Herne (1988) argues that the classification of Grimston bowls is ill-defined and confusing. He divides wares previously grouped under Grimston/Lyles Hill into carinated bowls, which do appear to be early, and plain bowls, which were made over a longer period. However, this division is not used in earlier papers, and "Grimston" ware has been dated as late as ca.2400bc, e.g. in the Midlands (May 1979).

Unfortunately, other portable artefacts are even poorer chronological indicators. Unperforated polished stone axes were used throughout the Neolithic, and continued in use into the early Bronze Age, being manufactured from about 3250-1750bc, though the third millennium bc saw the most intensive manufacture of axes (Vine 1982, Barnes 1982, Annable 1987). Spratt (1982) suggests that polished stone axes may not have been abandoned until they were replaced by bronze axes. Bradley (1978) suggests an even longer period of use for stone axes, as *"not until the Iron Age was a suitable replacement for the heavy stone tool found"*(p13). In this time there was little diagnostic change in form (Healy 1984). Group XVI axes are thought to be exclusively early, from 3,000 to 2,500 bc, (Vine 1982), but these are the products of a small factory, and of little use in dating axe distributions in much of the country. Polished stone axes may actually have appeared prior to other Neolithic traits in Britain. Polished stone axes have been found in late Mesolithic contexts in Ireland (Woodman 1978b), and pecked axes have been found at Nabs Head in Wales (David 1989). Though these may perhaps be interpreted as trade with or imitation of neighbouring Neolithic groups. Polished axes preceded other indicators of Neolithic culture in Norway by several millennia (Nygaard 1987, 1990), and they may not be an invariable indicator of full Neolithic-type culture in Europe.

Leaf-shaped arrowheads, while being typical of the early Neolithic, continued into the later part of the period. Richards (1990) claims that leaf-shaped arrowheads are restricted to the early Neolithic in southern England, being completely replaced by transverse arrowheads. This seems less likely further north where transverse arrowheads are less common.

The large majority of evidence for site distributions is from surface finds, often single axes or arrowheads. While arrowheads may often represent hunting activity, polished axes are often claimed to be related to settlement distribution (Spratt 1982). Murray (1980) distinguishes between two main behaviours leading to artefact deposition: discard and abandonment. Discard occurs when an item ceases to be useful, whereas

abandonment may occur when an item is still useful, and the owner intends to return for it, or when it is deliberately deposited for reasons other than the end of its usefulness. Stone axes were probably valuable because of the time necessary to produce them, and the frequently exotic nature of the material. Axes discovered are often in good condition, and their size also makes it unlikely that they were casually lost (Malmer 1984). Axe distribution patterns may represent more complex deposition than discard at the point of use.

Ritchie (1987) suggests that, because axes are rarely included as grave goods in tombs, unlike arrowheads, they are associated with settlement, not burial. As many polished stone axes are probably used as agricultural tools, either axes or mattocks (Reynolds 1977), they might be expected to represent agricultural areas. On the North York Moors there are few axes on the high moors, despite pollen evidence for clearance being carried out there, by some means other than fire. It is probable that valuable stone axes were not discarded where they were used, but brought back to the settlement (Spratt 1982). Axes may also have been used for wood working (Spratt 1982), or represent trade routes rather than agricultural areas. A slightly greater proportion of axes found on the east of the Pennines were found to be broken compared to those on the west. The eastern foothills are more suitable for agriculture, and axes may have been used for practical purposes more extensively here than to the west (Barnes 1982).

Cummins (1980) claims that the overall distribution of stone axes is "*not seriously distorted by modern collecting bias*" (p50). Axe hammers, which are subject to the same biases show a very different distribution to axes. While this assurance may be adequate on the national scale on which Cummins was working, more detailed comparisons with axe hammers and consideration of local biases seem necessary before this confidence in the distribution can be applied to all regions.

Beyond diagnostic artefacts identification of Mesolithic and Neolithic sites is problematic. Ploughing mixes artefacts from different periods together, making it very difficult to identify which industries belong to which period within surface scatters (Whittle 1990). Blades and blade cores are often assumed to represent the Mesolithic (Jacobi 1980a), but on excavated sites they are found in early Neolithic contexts (Richards 1990). Holgate (1988) accepts blade dominated industries as typical of the early Neolithic. As the artefacts on the soil surface represent as little as 2% of an assemblage, even total surface collections can be biased if soil conditions cause certain pieces to appear on the surface less frequently than others (Whittle 1990). The cultural associations of "diagnostic"

artefacts found mainly in surface scatters, e.g. tranchet axes, may be questionable (Gardiner 1990).

The problems of identification of industries typical of certain periods is probably more difficult in Scotland than in England. Chert and quartz, and occasionally other materials, are often used instead of, or as well as flint. Tool and waste flake forms are therefore unlikely to be exactly the same as those produced on good quality flint. Tools of atypical, rather than diagnostic type are obviously difficult to fit within existing typologies, most of which were constructed in England. Sites lacking recognisable type-fossils are difficult to date and place within a national chronology. For example, the shell middens preserved on the raised beaches of Scotland are often assumed to be Mesolithic. However, many lack diagnostic artefacts, and as some middens were used into the Medieval period simple assumptions of date would seem to be misleading. Some dated middens seem to have been used throughout the Mesolithic and Neolithic, e.g. Inveravon (MacKie 1972). Others, despite appearing no different to the Mesolithic examples are clearly Neolithic, e.g. Nether Kinneil (Sloan 1982,1984).

5.2 Distribution

Having discussed some of the problems and biases influencing the distribution of Mesolithic and Neolithic sites in Britain the distributions themselves can be considered. It has been argued in chapter 3 that by analysing the radiocarbon dates on a regional, rather than national scale, their temporal and spatial relationship becomes clearer, and their reliability can be judged more realistically. Too often Britain is treated as a single unit, which results in over simplification, and the blanket application of theory to areas for which it may be inappropriate. Young (1986) states that all archaeology must have a regional basis, and the renewed proliferation of regional studies in recent years demonstrates the acceptance of this principle.

Following this regional approach various reports from areas throughout Great Britain have been studied to compile a general impression of the distribution of late Mesolithic and early Neolithic sites. The type and standard of the reports is variable; research into the relevant period is not evenly spread, or equally thorough, thus confusing inter-regional comparisons. Within a region, different authors may concentrate on certain aspects of the evidence, and a more balanced picture is achieved if studies by different people are available for an area. Generally, recent studies are most useful, as they consider new developments in method and theory, many of which are concerned with assessing and, where possible, avoiding biases in the data.

In some areas the evidence is insufficient to identify confidently early Neolithic distribution from that of the late Neolithic. This is especially true where leaf-shaped arrowheads and polished stone axes are used as the main indicators of activity. Local factors affecting survival and discovery of sites are generally discussed by the authors of the reports, so some impression can be gained of which aspects of local distribution are likely to be genuine. The importance of research bias has been repeatedly stressed, and more information is being continually added to that used here, changing the understanding of distribution patterns. Negative evidence, therefore, must be treated with extreme caution.

Though in most cases I have accepted individual authors' definitions of early and late Neolithic, where information was gathered from inventories, and sites mentioned were not securely dated, type fossils had, unfortunately, to be relied on as dating evidence. It was thus assumed that all enclosures identified by aerial photography were late Neolithic or later, unless they were state^d to have causewayed ditches.

Figures 5.1-5.6 have been compiled from regional studies containing suitable maps. The information contained in them is, therefore, restricted by the type and availability of source material. The object of the chapter is to identify general trends, it does not claim to be a complete representation of existing knowledge of site distribution for these periods. Greater completeness could, not doubt, be achieved, but only at the expense of research into other chapters. As a compromise a wide range of areas across Britain have been studied, and areas for which information was not available, or time limits merely did not allow to be studied, have been indicated. Studies concerned with the distribution of surface finds do not necessarily map the location of monuments, and vice versa, so even within areas covered not all classes of site may be indicated on figures 5.1-5.6. The use of the catalogue of Mesolithic sites in England and Wales (Wymer 1977) was considered in an attempt to fill some of these gaps, but the catalogue contains minimal interpretation, and little information to allow the division of sites into early and late Mesolithic. It was considered that the increased accuracy would not be sufficient to justify the time spent processing the information from the catalogue. The scarcity of good distribution maps for Neolithic surface finds from Scotland, and the accessibility of the NMR, made the construction of a distribution map from the information in the NMR worthwhile. Despite these qualifications it is hoped that the scope of this chapter is broad enough to identify general trends. The intention is to assess what interpretations can validly be drawn from the spatial distribution data, rather than to present an exhaustive survey of that data.

England and Wales will be divided into regions for discussion. These regions are fairly arbitrary groupings of counties with some geographical unity. Scotland will be discussed as a whole, with reference to specific areas as examples, because much of the literature either details with the whole country or small areas of it.

5.2.1 England and Wales

5.2.1.1 Northern England

(figures 5.1a and b)

With the notable exception of the North York Moors, site distribution in both periods in Northern England is largely coastal and riverine. Masking by blanket peat and the unevenness of research appear to be the major taphonomic factors influencing the distribution of sites in this region (Young 1986, 1987, Bonsall 1980, and see appendix VI).

The coastal location of many cities in this region, and the masking effect of alluvium in some river valleys (Spratt 1982), seems only to cause a few gaps in the general pattern. The avoidance of uplands by the sites is clear throughout much of the area, but the concentration of Mesolithic sites on the high moors of the North York Moors suggests that not all ancient activity avoided the uplands. The discovery of late Mesolithic sites in molehills and rabbit holes on the limestone uplands east of Shap (Cherry 1989), suggests there might have been activity on the uplands elsewhere in Cumbria, and masking by vegetation may significantly influence site distribution. There are more Neolithic than Mesolithic findspots on higher land in Cumbria, possibly because many of these finds are polished stone axes, which are more easily visible than lithic debitage. The presence of the axe factory in Great Langdale may also have encouraged the search for this particular class of artefact in this area.

On the North York Moors late Mesolithic sites are concentrated on the high moors, above 300m, usually clustered on watersheds, and near spring heads. It might be expected that flint scatters are concentrated on watersheds because that is where peat erosion occurs, allowing the scatters to be discovered. However, late Mesolithic lithic scatters are also found on the watersheds in the arable Hambleton Hills, where discovery depends on ploughing, not peat erosion (Spratt 1982). This suggests the watershed location is a trend resulting from ancient activity rather than taphonomic factors.

Polished stone axes in northern England are rarely found on uplands (Annable 1987). Where flint scatters are common it seems unlikely that axes have been overlooked, and their absence might be considered significant (Spratt and Simmons 1976). The distribution of Neolithic stone axes in North Yorkshire is densest on the chalk of the Tabular Hills, and of medium concentration on the boulder clay lowlands near the rivers Tees, Esk and Leven, along the coast, and in the dales (Spratt and Simmons 1976). Axes are almost absent from the high moors. The distribution of barrows confirms this pattern, suggesting that it is of some significance, as the two artefact types are subject to very different factors of survival and discovery (Spratt 1982). In contrast leaf-shaped arrowheads have been found on the uplands in similar locations to late Mesolithic flint scatters (Spratt and Simmons 1976). It would seem reasonable to interpret the distribution of axes and barrows to indicate, approximately, the location of residential sites, with the arrowheads representing hunting activity.

The upland late Mesolithic sites are dominated by microliths, and probably represent hunting activity, compared to the lowland base camps, which have numerous scrapers and other tools, in addition to microliths. Most lowland sites are diffuse scatters

along the river Tees, and round the prehistoric lakes of the Vale of Pickering. There is little evidence to suggest that these were major settlement sites, seasonal activity sites being more probable (Spratt 1982). The distribution of Neolithic axes around the fringes of the Vale of York (Radley 1974) may imply that while both late Mesolithic and early Neolithic residential sites were lowland the former favoured riverside locations, whereas the latter avoided them. However in many areas of northern England, e.g. the northern Pennine dales (Coggins et al 1989, Young 1986), and the Milfield basin, Northumberland (Miket 1976) sites of both periods occur in similar locations on river terraces and lower hill slopes to avoid flooding.

There is some indication that Neolithic hunting activity was variable in this region. Cherry (1989) found that leaf-shaped arrowheads were more common on the limestone uplands between Shap and Kirkby Stephen than on the coastal plain. Early Neolithic pottery was found in association with the inland flint scatters, suggesting longer term occupation than for temporary hunting sites. It is impossible to determine whether this was due to the inland groups depending more on hunter-gathering than coastal groups, or whether exploitation of wild resources on the coast involved marine rather than terrestrial resources. If hunting had cultural as well as economic significance the possible explanations might be more complex.

Cumbria, the North York Moors and Weardale are discussed above because most work has been carried out in these areas. The North York Moors are well known for flint scatters, so attracting further research. Local collectors are active in many parts of Britain, but their work can remain unknown unless synthesized and published like Young (1986, 1987) did for Weardale. The large majority of early sites on the Cumbrian coast are known of because of the work of Cherry and Cherry (1983-1987), indicating how strongly individuals can influence the known distribution. The confinement of Late Mesolithic sites to the coastal lowlands is probably due to the Cherrys' survey work being restricted to the ploughed fields in this area. However, despite walking fields along most of the coast from the Solway down to Walney Island Mesolithic sites were not evenly distributed. These sites tend to concentrate round the St. Bees Head area, and the estuaries of the Esk and Irt, and the existing evidence suggests these are discrete concentrations rather than merely the products of patchy fieldwork.

Annable (1987) argues that the concentration of Neolithic axes in Cumbria is not due to post-depositional biases, ploughed land being equally extensive in the north-east, but axes less frequent. However, differential local interest in prehistory could be as significant as availability of ploughed land in the formation of the observed distribution.

There are few known Mesolithic flint scatters from Northumberland, but intensive field walking in the Milfield basin revealed previously unknown sites (Miket 1976). Miket (1976) also reports that only 5 long cairns had been recognised in Northumberland, which like the Mesolithic sites is probably due to inadequate research than sparse occupation in antiquity.

Other taphonomic factors, though less important on a large scale, still seem to have an influence on the distribution pattern. There is little evidence of Neolithic occupation from the Vale of York, but this is probably due to its masking by later deposits, as it seems unlikely that such a fertile area was uninhabited (Whittle 1977). Though there is a fairly strong coastal distribution in both the east and west, the east coast has probably lost more sites to coastal erosion, as represented by late Mesolithic and early Neolithic artefacts which have been dredged from Hartlepool Bay (Tooley 1978). Deposition has occurred round the Esk/Irt estuary, preserving the ancient coastline, and the sites located on it (Bonsall *et al* 1986, 1989).

While gross patterning seems to be controlled largely by taphonomic factors there do seem to be some differences between different areas and periods that can be attributed to ancient activity. The discrete concentrations of late Mesolithic sites on the Cumbrian coast, and the decline in activity on the higher North York Moors from the Mesolithic into the Neolithic seem to be real trends. The former could represent groups with restricted mobility, who may have been responsible for some of the early woodland disturbances seen in the pollen record for Cumbria. Such groups could have been receptive to the concepts of agriculture. The relationship between probable Mesolithic and Neolithic hunting sites demonstrates a continuation of activity, though hunting seems less important in the Neolithic, but this demonstrates little about possible continuations of culture or population. The practice of farming either by incomers or natives is likely to have caused some shift in site location and to the economic importance of hunting.

The distribution of Neolithic artefacts implies the importance of fertile, light soils for the early farming communities, but boulder clay areas also seem to have been inhabited. The heavier soils may have been used mainly for pasture (Spratt 1982). Over most of northern England polished stone axes are located in areas of boulder clay below the 180m contour (Annable 1987). Axes do not represent all Neolithic activity, as they are scarce on the east coast, but Neolithic activity there is demonstrated by other finds (Spratt 1982), especially the long cairn at Street House, Loftus (Vyner 1984). Early Neolithic pottery is rare in northern England, and has only been found during excavations, not during field walking (Miket 1976).

5.2.1.2 Pennines and Midlands

(figures 5.2a and b)

This region is dominated in the late Mesolithic by the concentration of sites on the Pennines. These hills are famous for their flint scatters, which have been known and studied since last century. To some extent the concentration of research activity on the Pennines seems to have attracted attention from the lowlands (Keighley 1981). Late Mesolithic sites have been recovered from most of the length of the Pennines, though the major concentrations are on the central portion, with sparser distributions to the north and south. This may be due to a concentration of collecting activity in the central Pennines (Barnes 1982). The location of sites on the high moors does not seem to be entirely due to peat erosion, as the sites do not correlate well with maximum peat erosion. In some areas every erosion patch reveals flints, whereas in others, with similar degrees of erosion, flints are scarce (Barnes 1982). The altitudinal distribution suggest that the sites were probably located in the more open woodlands of the forest-edge zone (Jacobi *et al* 1976).

The clustering of late Mesolithic flint scatters found on the North York Moors can also be seen in the central Pennines (Jacobi *et al* 1976), where sites are grouped round routeways and passes, in sunny locations, close to streams (Keighley 1981, Barnes 1982). Site locations appear to be related to drainage, sandstone sites being preferred to gritstone (Clark 1932, Leach 1951, Manby 1963b), and boulder clay generally avoided (Keighley 1981). The absence of late Mesolithic, and early Neolithic, material on the magnesium limestone of West Yorkshire is probably due to the loss of sites to later cultivation in this fertile area (Keighley 1981). Occasional foothill and lowland sites have been recorded, in locally dry, sunny locations (Barnes 1982, Keighley 1981).

Mesolithic sites are rare in the Midlands. There are some late Mesolithic flint scatters, as defined by microliths, in the Trent basin, generally close to the river or a tributary (Manby 1963b), in Northamptonshire (Martin and Hall 1980, RCHME 1979b), and in Warwickshire (Saville 1981). Most are concentrated on sandy soils, often on south facing slopes and vantage points. More field work would probably reveal many more late Mesolithic sites in the Midlands.

In general early Neolithic finds are dispersed in the Pennines and the Midlands, and there are few concentrations indicating early Neolithic settlement, even in the Peak District where Neolithic remains are most common. Despite the presence of long cairns, which are most probably early Neolithic, there seems to be little actual settlement in the area (Hart 1986, Bramwell 1973). Few early Neolithic artefacts, except arrowheads, are

found on the Pennine uplands, and some areas, such as the moors above Burnley, have very few Neolithic finds of any sort (Leach 1951). Leaf-shaped arrowheads are often found in conjunction with Mesolithic flint scatters (Barnes 1982), and probably represent continued hunting on the uplands (Keighley 1981). Polished stone axes in the Aire valley are concentrated on the lower valley slopes, suggesting the existence of settlements in these locations. There is also a concentration of flint scatters on the alluvium of the valley floor (Keighley 1981). The acid bedrocks of the central Pennines probably meant that soil on the uplands was shallow and poor even in the Neolithic period, and farming would largely have been restricted to the brown forest soils of the foothills (Barnes 1982).

Chambered tombs in Derbyshire and the Midlands are mainly located on uplands. The destruction of lowland monuments by agriculture may explain the concentration of chamber tombs on the uplands round the Trent basin. However, even those on the uplands have not escaped damaged. Stone robbing has made some difficult to identify, and may have rendered others unrecognisable (Vine 1982). There are a small number of Neolithic settlement sites identified in the Trent basin, all have Grimston pottery, though some have fairly late dates (Vine 1982). Aerial photography has revealed sites in the Trent valley, including 2 interrupted ditched enclosures, of probable early Neolithic date.

The use of axes to indicate early Neolithic activity is particularly doubtful in this region. Axes from West Yorkshire (Barnes 1982) and the Trent Basin (Vine 1982) are specifically mentioned as originating mainly from factory sites not active until the middle of the Neolithic possibly suggesting little occupation until this period (Vine 1982). In the Trent basin stone axes are concentrated on the southern slopes of the Pennines, and on the carboniferous limestone, possibly because these have soils suitable for early agriculture. There are fewer on the lowlands, but these are widespread, and concentrated on alluvial deposits rather than on boulder clay (Vine 1982).

The scarcity of early finds in the Midlands is often attributed to the heavy clay soils, which are assumed to be unsuitable for early agriculture. Though avoidance of clay soils is detectable in many areas, it does not seem to be universal in the Midlands. In Leicestershire clay soils cover 60% of the county, and 60% of the early Neolithic sites are found on clay soil, therefore soil type does not seem to significantly influence site location in this area. The clay sites do not represent only temporary hunting sites; there seems to have been settlement as well (Clay 1989). Northamptonshire was also thought to have little pre-Iron Age archaeology, but detailed fieldwalking has revealed earlier sites, though these seem to avoid the clay soils (RCHME 1979b, (Martin and Hall 1980). Soil under the

forest would be fairly uniform when first cleared, and variations would only become evident after some time under cultivation (Limbrey 1978, Edwards 1978). Variations in early site distributions related to soil types may, therefore, be more closely related to recent agricultural activity than to early settlement patterns. Gibson (1989) considers that the true reason for the lack of archaeological evidence in the Midlands is the fertility of the soil, not reverse. Continuous farming in the region, since the Neolithic, has destroyed many of the early sites.

In central England the contrast between the distribution of Mesolithic and Neolithic sites is quite distinct. Riverine distribution seems rather weak in the Mesolithic, though this is probably due to the scarcity of work in lowland areas. The Neolithic distribution is strongly riverine, but generally avoids the uplands, unlike the Mesolithic scatters. Even in the Peak District where there is upland early Neolithic activity it is mainly represented by burial cairns rather than evidence of occupation sites. Even Neolithic hunting activity appears to have been much less on the Pennines than on the North York Moors. With the late dates from some Pennines Mesolithic sites in mind it is tempting to claim that the distribution pattern represents the avoidance of Mesolithic groups by Neolithic ones in this region. However, the evidence from the North York Moors suggests that only Neolithic hunting activity might be expected on the uplands, and collections from Cumbria indicate that the degree of hunting activity may have varied in different areas. Neolithic groups with little economic or cultural need to hunt may have avoided the uplands whether or not Mesolithic groups continued to live there.

5.2.1.3 Eastern England

(figures 5.3a and b)

Sandy soils are important in defining the distribution of both Mesolithic and Neolithic sites in Lincolnshire and East Anglia. Most of the East Anglian Mesolithic sites are on the sandy soils bordering the Fens, mainly as a result of the good collecting conditions, and a history of research (Clarke 1960). Early sites in Lincolnshire appear to be concentrated on sandy soils around the Scunthorpe and Grantham areas (Vine 1982). Find recovery is easy in these conditions, and intensive fieldwalking west of Grantham demonstrated that sites can be found on other subsoils (May 1976). There are numerous Mesolithic sites on the Jurassic Ridge, the western edge of the Wolds, though few artefacts attributable to the Mesolithic were found when a transect was fieldwalked across the Lincolnshire Wolds (Phillips 1989), and the crest of the Lincolnshire Edge (May 1976).

There are numerous Neolithic sites on the sandy soils of East Anglia: in the Brecklands, the Ipswich area, and east Norfolk, though they also occur on the chalk ridge (Clarke 1960). Neolithic occupation in Norfolk is concentrated on lighter soils, in the loam region of north-east Norfolk, and in the mid-Norfolk river valleys (Healy 1984). This preference for light, dry soils may be real as the early Neolithic sites, such as Spong Hill (Healy 1987) and Peacock Farm (Clark and Godwin 1962) are situated on local patches of sand and gravel in an otherwise boulder clay landscape. The loam soils of Norfolk seem to have been important in the early Neolithic despite the equalising effect of the forest. They have a component of loess, making them light and fertile, but able to retain moisture, and therefore particularly good arable soils once cleared (Murphy 1984). The effect of millennia of farming means that present soils are not a good indication of their past nature (Sheldon 1978). The evidence for post-glacial soil changes is scanty, with a relatively few buried soils to indicate past soil types (Murphy 1984). Extrapolation from present soils is therefore problematic, but site distribution does seem to be related in some way to subsoil type. To a large extent this is due to the effect of different soil types on research, but there may also be a suggestion of the real distribution.

Locally elevated positions are also favoured, and extensive scatters of pits found on excavated sites suggests either large settlements, or the repeated settlement of a favoured place (Healy 1984). Aerial photography has been important in East Anglia for extending the known distribution of causewayed enclosures, there being 2 identified in Norfolk (Healy 1984).

The true pattern of axe distribution in Lincolnshire is hard to recognise because it is severely distorted by collection biases and masking. The concentration of axes in the north, and the patchy distribution on the limestone and chalk, is mainly due to patchy research. The relative scarcity of axes in the Fens and coastal plains could be due to peat growth, and the deposition of silts, rather than a lack of activity (May 1976). The Lincolnshire Wolds produced quantities of Neolithic flint work despite the lack of Mesolithic pieces (Phillips 1989).

In East Anglia pebble mace-heads, tranchet axes and microliths are concentrated along the fen-edge, and on the Brecklands, but Neolithic artefacts are more widely distributed. While Tilley (1979) interprets the distribution of tranchet axes as Mesolithic winter settlement, later activity could also be represented if these axes continued in use into the Neolithic period as Gardiner (1990) proposes. Neolithic projectiles have much the same distribution as microliths, and polished axes follow the distribution of flaked ones

(Tilley 1979), perhaps suggesting some continuity in exploitation of the area, if not actual cultural continuity.

Though there is a large number of sites in Breckland, there is little evidence of Neolithic settlements. What evidence there is, predominantly pot sherds, is concentrated close to the river Little Ouse. Even the lithic distribution, while not as strictly riverine as the pottery, seems to be influenced by the river, most lying in a belt 2.5km wide along the north bank of the Little Ouse. The area has one of the lowest rainfalls in Britain, so water was a severe limitation to settlement location, and the river particularly important. Elsewhere in Norfolk rivers were probably of importance as routeways; 7 out of 9 early Neolithic sites in Norfolk are close to navigable rivers (Healy 1984).

Again detailed patterning would appear to be due to patchy field work, but there is a general similarity between late Mesolithic and early Neolithic distributions. Both distributions are strongly riverine, though there seems to have been more early Neolithic activity on the Lincolnshire Wolds. Activity in the Fens was probably very similar in both periods, but that only suggests similar adaptations to the same environment.

5.2.1.4 Southern England

(figures 5.4a and b)

Much work has been carried out on both periods in southern England, so this region perhaps suffers less than others from distortion of distribution patterns by patchy research. A fairly large proportion of the region is ploughed, there is a concentration of modern population, and a general interest in the prehistoric is probably encouraged by the more spectacular monuments of the area. All this favours widespread field work. Mesolithic base camps in southern England seem to have been concentrated in the lowlands, usually along rivers, on the drier parts of the flood plain, by lakes and streams (Whittle 1990, Lambrick and Robinson 1988). Late Mesolithic activity extended over the higher terrace gravels using locations later settled by Neolithic farmers (Case 1986). In Oxfordshire (Tingle 1987) and Wiltshire (Richards 1990) the Downs appear to have been little used in the late Mesolithic, probably because they were too dry for occupation, and the lack of surface water would restrict the availability of game animals (Whittle 1990). However, Mesolithic activity on the chalk in Hampshire has been demonstrated by the consistent recovery of microliths, due to intensive surveying, and may be represented by the presence of tranchet axes on the South Downs. There is a clear distribution of late Mesolithic sites along the edges of clay-with-flints deposits on the Dorset chalklands, and

this may also apply to north-east Hampshire (Gardiner 1984). In Gloucestershire Mesolithic activity is concentrated on the Cotswold hills, though there is no reason why other habitats were not exploited. The distribution is probably due to sites being revealed by ploughing on the Cotswolds, and concealed by alluvium in the Severn valley (Saville 1984).

In south-east England there was an apparent concentration of late Mesolithic sites on the lower Greensand. Recent survey work has shown that late Mesolithic activity expanded onto all major geological outcrops; only base camps actually seem to be preferentially located on Greensand (Gardiner and Shennan 1985). The apparent concentration of sites on this deposit might partly be explained by it being less intensively used in later periods than others, so Mesolithic scatters are not masked or confused with early Neolithic ones (Jacobi 1981). There are fewer sites on the chalk, but microliths are harder to spot on chalk than on sandy soils, which may partially explain the under-representation of late Mesolithic activity on the Downs (Jacobi 1978).

In East Berkshire Ford (1987b) found early material concentrated on the London clay, in locally well draining locations, e.g. on gravel terraces, and small hillocks above the flood plain., but could not securely separate late Mesolithic and early Neolithic activity. The large number of polished stone axes from the Thames suggests considerable Neolithic activity in the lower Thames valley, though the axes are often interpreted as being lost in transit, and may not necessarily represent settlement (Adkins and Jackson 1978). In clayey areas concentrations of Mesolithic finds are situated in local areas of drier soil (Jacobi 1978). Findspots rarely occur singly, and there are a large number of sites in certain areas. Most findspots in a group tend to be of the same period, suggesting reuse of favoured locations (Jacobi 1981).

The scarcity of microliths in Essex makes the late Mesolithic difficult to distinguish from both the early Mesolithic and early Neolithic. The similarity in the distributions patterns for late Mesolithic and early Neolithic for this county may be explained by this confusion as to which site should be attributed to which period. Even where numerous microliths have been found, e.g. near Shore Point, these have been redeposited from submerged sites off the coast, and are mixed with finds from later periods (Jacobi 1980a). Hedges (1980) claims that early Neolithic lithic industries "*appear to be virtually absent*" (p34) in Essex, possibly due to confusion with the Mesolithic material rather than genuine absence. Axes are numerous, with a purely coastal and riverine distribution, though leaf-shaped arrowheads are scarce. Some early activity may be indicated by Windmill Hill type pottery found on some excavated sites. It is possible

that there was little early Neolithic occupation of the county, though this would be surprising considering the quantity of Mesolithic and later Neolithic material (Hedges 1980).

The strongly valley based nature of both the late Mesolithic and early Neolithic seen in much of southern England has not been fully tested by fieldwalking, away from the well known valley sites (Whittle 1990). However, where fieldwalking has been carried out Mesolithic and Neolithic sites do seem closely related (Holgate 1988). In one area of the Thames valley studied by Ford (1987b), early material, identified by blade industries, was concentrated on the river gravels and lower slopes. Schofield (1987) also notes the intensive exploitation of valleys in southern England, as far as can be identified from flint scatters, and a different, more extensive exploitation of inter-valley areas.

In south-east England there is a definite concentration of early Neolithic sites on the chalk, though distributions of monuments, stone axes and flint scatters do not necessarily coincide. Long barrows and mortuary enclosures in the Upper Thames valley, unlike their counterparts in Wiltshire, are located on the river gravels, close to the settlement sites (Bradley and Holgate 1984). Though the monuments of Wiltshire are located on the Downs, flint scatters round Stonehenge, presumably representing Neolithic settlement, are restricted to the valleys (Richards 1990). In Gloucestershire Neolithic monuments are concentrated on the Cotswolds, despite it being the main arable area, where losses should have been greatest. There are no purely Neolithic flint scatters in the county, but Neolithic elements appear on Mesolithic scatters, also concentrated on the Cotswolds (Darvill 1984).

The variation in early Neolithic site distribution is highlighted by Gardiner's study of Sussex, Hampshire and Dorset (1984). Despite forming a geologically consistent unit the distribution of early Neolithic sites in these counties varies significantly. In Sussex recognisably early Neolithic flint scatters are far fewer than Mesolithic ones, and are concentrate in locations suited to farming. Long barrows are predominantly in similar areas, but causewayed enclosures are located on hilltops, at the periphery of the main lithic distribution (Gardiner 1984, Bell 1977). In Hampshire monuments and settlement are not so closely associated. All the Hampshire long barrows are on Upper Chalk, while polished axes are mainly distributed on other geologies (Fasham and Schadla-Hall 1981). Clay-with-flint deposits tend to be the focus for settlement location and this has been assumed to be due to the accessibility of flint. However, these deposits would probably have been covered by light, fertile, well drained loess soils, since eroded away, which would have been highly suited to Neolithic agriculture (Gardiner 1984, Bradley *et al* 1984). Particularly in East

Sussex early Neolithic sites seem to be concentrated on these deposits with little activity elsewhere, suggesting the strong influence of soil fertility on settlement distribution (Gardiner 1984).

Visibility seems to have been an important locational factor for long barrows; most of those in Hampshire are between 60-120m OD, and often make use of minor ^{graphical} topological feature to achieve the most commanding position (RCHME 1979a). In east Dorset settlement seems to be on the coastal plain, but the barrows, along with the causewayed enclosures, are still located on the higher chalklands, a considerable distance from settlements (Gardiner 1984). Field and Cotton (1987) have suggested that the chalk in Surrey may have been mainly an industrial area for flint exploitation and possibly pastoralism, rather than settlement as elsewhere in the county, because of the lack of pottery on the chalk, and the difference in the flint assemblages compared with the rest of the county.

Unlike the Pennines where leaf-shaped arrowheads are widely scattered, some Oxfordshire sites have large concentrations of them, and Case (1986) has interpreted these as hunting stands. Excavation in the Welland valley revealed activity on the floodplain to have been purely temporary, and of a possible ritual nature. Despite the good preservation of features below the alluvium no evidence of settlement was found, and the deposition of alluvium in the Neolithic period demonstrated that the area was subject to flooding (French 1990). The continued importance of hunting, and the seasonal use of some areas can, therefore still be seen in the early Neolithic.

The relationship between Mesolithic and Neolithic distribution patterns in southern England seems to vary significantly. On Cranbourne Chase there is little evidence of either late Mesolithic or early Neolithic settlement (Bradley *et al* 1984), in the Upper Thames valley settlement sites of both periods are numerous, and in the north Weald which had many late Mesolithic sites seems to have been avoided by the early Neolithic (Whittle 1990). However, the period to which many flint scatters can be attributed is uncertain, as only diagnostic artefacts identify a scatter as Mesolithic or Neolithic (Bell 1977). Both late Mesolithic and early Neolithic assemblages are poorly dated and difficult to distinguish if no diagnostic artefacts are present (Gardiner 1984). Where flint scatters cannot be identified to period, this confusion may prevent comparisons between distribution patterns in the two periods.

5.2.1.5 South-West England

(figures 5.5a and b)

Identification of the distribution pattern of late Mesolithic sites in the South West is hampered by the poor division between early and late Mesolithic. There has also been some loss of Mesolithic sites to rising sea levels; some (e.g. Westward Ho! midden) are still visible at low tide (Grinsell 1970, Churchill 1965). Most demonstrably late Mesolithic sites in the South West are located on present cliff tops or on granite uplands. On Dartmoor blanket bog masks the full extent of the distribution, sites only being recognised on cultivated land, peat cuttings, or areas of erosion round edge of the blanket bog. Peat cutting and land reclamation at Princetown demonstrated that there are sites hidden below nearly 2m of peat. Coastal sites seem well located to exploit various marine resources, and uplands may have been used for seasonal hunting (Jacobi 1979). Intensive field walking in the Exe valley produced more early than late Mesolithic artefacts, suggesting to the authors that there may have been a shifted in the focus of late Mesolithic activity, from south Devon to the north Devon coast and Dartmoor (Silvester *et al* 1987). Late Mesolithic sites interpreted as base camps have been identified in Penwith (Jacobi 1979, Roberts 1987). The Isle of Lundy appears to have had some Mesolithic occupation, and the Scilly Isles may have provided temporary refuge for Mesolithic fishermen, though little Mesolithic material has been found there. Lundy and the Scilly isles would have been islands even early in the post-glacial, and must have been reached by boat (Jacobi 1979).

Neolithic axes are much more widely distributed, covering much of the lowlands, especially along the coast and river valleys, but avoiding the granite uplands (Jacobi 1979), though Neolithic monuments do not (Mercer 1986). The lack of work on the Neolithic in North Devon distorts the distribution pattern, but fieldwalking has been carried out on Exmoor, and failed to recover arrowheads from the main massif. Early Neolithic settlement sites seem to be particularly concentrated in the valley between Brendon and the Quantock Hills (Grinsell 1970).

The distribution of quoits, "dolmens" of simple but massive construction, cannot be used to determine the distribution of early Neolithic activity in the south-west. They are even more poorly dated than most monumental structures; the few artefacts associated with them are usually early Bronze Age, though these can probably be attributed to secondary activity (Mercer 1986). Long barrows have been identified in West Penwith, but they are poorly preserved, suggesting an unknown number have probably been destroyed without trace, and those surviving are unlikely to be recognised without extensive field survey. Long cairns and entrance graves are probably related to the early Neolithic and are

found in coastal and moorland location (Mercer 1986). Again it is unclear whether early Neolithic activity is concentrated in western Cornwall because of the presence of several axe factories, or whether the concentration of moorland and research have allowed the survival and discovery of more monuments.

In general late Mesolithic and early Neolithic activity in the south-west seems to be concentrated in similar places, with no suggestion that the two cultures represent contemporary groups, who were attempting to avoid each other (Mercer 1986).

5.2.1.6 Wales

(figures 5.6a and b)

In Wales the less accessible uplands, covered with moorland and blanket peat, seem to have had an important influence on the site distribution. The early Neolithic sites have a strongly lowland distribution, as had the late Mesolithic sites until work on the uplands of Glamorgan revealed numerous sites (Jacobi 1980). No Mesolithic base camps have been found in the Welsh Marches, but there is a scatter of sites along the Severn valley suggesting very transitory occupation, possibly indicating the use of the river as a routeway. Alternatively, the rarity of diagnostic implements could be due to the existence of an atypical flint industry, possessing few diagnostic artefact types (Stanford 1980). There is a concentration of findspots in Pembroke, possibly due either to intensive fieldwork there, or to the mild winter weather (David 1989). Shellfish beds may have been particularly plentiful, as they would have suffered minimum frost damage in the mild winters. This could have encouraged Mesolithic settlement in the area (Jacobi 1980b). The earliest Neolithic in Wales seems to have been mainly coastal (Savory 1980), but as the modern population distribution is largely coastal, and the chances of finds being made is higher near centres of population, this may not reflect past settlement patterns.

In the Welsh Marches the distribution of polished stone axes covers both river valleys and uplands, with scatters of Neolithic finds in the Black Mountains at altitudes over 450m OD. Other findspots are on hills 120-180m OD. The 20km² area round Clunbury has the highest density of Neolithic finds in the Marches, but like the other findspots it is hard to tell how early these are. The presence of Neolithic tombs in the Marches suggests that more artefacts would be found if more fieldwork were carried out (Stanford 1980).

5.2.2 Scotland

5.2.2.1 Introduction

Woodman (1989) has recently protested at the state of Mesolithic research in Scotland. Due to a period of stagnation after the 1940's Lacaille's Stone Age of Scotland (1954) is still the major work on the period, though Hunt (1987) has brought Lacaille's work up to date, he has been able to add little to the Mesolithic information from much of the country. Recent research has improved the state of knowledge in certain areas, especially the south-west (Affleck *et al* (1988), Finlayson (1990), Edwards *et al* (1983)), and the Hebrides (Wickham-Jones (1990a), Mellars (1987), Mithen (1989)). However, there are still large areas about which very little is known.

The Neolithic has received more attention, the most notable body of information being the surveys of cairns carried out by Henshall (1963, 1972). Hunt (1987) has provided a catalogue for the Neolithic in Scotland, in much the same way that Lacaille did for the Mesolithic. The Orkneys have been the focus of much attention, but excavation elsewhere has been restricted mainly to funerary monuments and other ritual sites, many of which have not been fully published (Kinnes 1985). What is lacking for both periods is a general indication of which areas were occupied. This has been achieved in many parts of England by fieldwalking. Despite its many faults methodical fieldwalking is often the only way to obtain this information, especially for the Mesolithic, when no large, prominent monuments were built. Even haphazard collection can give useful indications of areas which would repay further study.

Scotland is hindered in this respect by the low population density over much of its area. Most Mesolithic sites have been found in the southern half of Scotland, almost certainly reflecting the present, rather than past population distribution. New sites found by amateur enthusiasts are almost always near their homes. Collection is also hindered by the scarcity of ploughed land in many areas. Much Scottish blanket bog is stable, unlike the eroding peat of the Pennines which has revealed many sites. Only forestry activity can give an indication of activity in the highland areas (Woodman 1989).

Despite the problems, there is still much land that can be successfully field walked, and much information to be gained through this approach. Perhaps due to the hiatus in professional interest in early Scottish prehistory, there is less of an amateur tradition of collection than in many areas of England. While some particularly productive areas, such as the Tweed valley, support local collectors, whose collections have

occasionally been studied (Haley 1990), there is little organised fieldwalking by local societies. In some English counties, e.g. Leicestershire, local amateurs have been encouraged to carry out methodical walking, properly recorded, which can add significantly to local knowledge about all periods, not just prehistory (Liddle 1985). An exceptional example of such work in Scotland is a project under taken by the Lanark and District Archaeological Society in which 300 acres were walked over 11 months in advance of forestry (Clarke 1989). This not only added to Lacaille's sites in the area, but also provided accurate information on the spatial distribution of the artefacts. Clarke stresses the usefulness of this type of work, and the need for professional bodies to provide encouragement and training.

5.2.2.2 Site distribution

This summary relies heavily on the work of Lacaille (1954) and Hunt (1987) both having considered the same problems as are covered by this chapter. There are regional summaries for the North-East and South-West of Scotland, and of course Orkney, but most work has concentrated on individual sites rather than landscape studies. Distribution maps of stone axes and leaf-shaped arrowheads are lacking for Scotland, so I have produced such a map (figure 5.8) from the information in the National Monuments Record (NMR). All unperforated polished stone axes, and leaf or heart-shaped arrowheads recorded in the NMR are included on the distribution map. The number of arrowheads is small, because most records of arrowheads do not specify their shape, and so were excluded from the map. The distribution of surface finds can be compared to the distribution of Neolithic tombs (figure 5.9) gleaned from the NMR by Hunt (1987).

Mesolithic

(figure 5.7)

Until recently there was no evidence for Mesolithic occupation of Orkney, and evidence for a Mesolithic presence in the north of Scotland in general is scanty. Fraser (1983) suggests that Mesolithic occupation of the north of Scotland was ephemeral, and expresses some doubt over the attribution of Mesolithic-type material from this area to that period. However, the scarce and insecure nature of Mesolithic sites in this area is mainly due to the lack of research, which is to be expected in an area so sparsely occupied at present. Hunt (1987) concludes that the evidence for the Mesolithic in Scotland is "*disappointing*" (p11), not because of a lack of sites, but because of poor recording, care of find collections, and lack of excavation.

It seems probable that there was Mesolithic activity on the Northern Isles. Ritchie (1975) has claimed that a survival of Mesolithic techniques in the flint work at Knap of Howar seems possible. Recent work has been carried out by Wickham-Jones (1990b and pers. comm.) involving a re-examination of existing lithic collections from Orkney. Mesolithic elements, defined as microliths or blades were confirmed in assemblages from eight sites, most on Mainland. The use of blades alone to identify Mesolithic assemblages is dubious, but the presence of microliths shows there was a Mesolithic presence, and further research is needed to suggest the full extent of this. The existence of two sources of flint, and three of chert, in addition to the presence of glacial erratics, may have made Orkney worth colonising from an early period (Fraser 1983). There is little Mesolithic activity yet reported from the Outer Hebrides, though the NMR contains a reference to a site at Daliburgh, South Uist, which has produced numerous flints, apparently including microliths. The experience of Orkney would suggest that more sites might be expected to be found. Late Mesolithic sites have been found throughout the Inner Hebrides (Mithen 1989, Mercer 1970-71, 1974a, Mithen 1990, Wickham-Jones 1990).

Many sites in Southern Scotland have both Mesolithic and Neolithic artefacts present, which may suggest some degree of continuity of occupation in the area. Shewalton Moor and Luce Sands in the south-west have Neolithic pottery on Mesolithic sites (Lacaille 1954, Morrison 1982). Various sites in Scotland indicate a degree of economic continuity from the late Mesolithic into the Neolithic and Bronze Age. Shell middens were used into later periods, often with later activity on middens initiated in the Mesolithic, e.g. some of the Oban middens (Pollard 1990), Ulva cave, Argyll (Bonsall *et al* 1987, 1992), Inveravon, West Lothian (MacKie 1972). Pollard (1990) has used this evidence to suggest cultural continuity, with the adoption of some typically Neolithic traits, particularly burial monuments. It seems probable that hunting and gathering remained economically significant in parts of Scotland, but it is unclear whether this was true economic continuity or practical opportunism. Along the west coast cereal growing was probably highly restricted by climate and suitable land, possibly resulting in the need to rely on supplements of wild resources.

Neolithic

(figures 5.8 and 5.9)

On a national scale certain patterns of the Neolithic distribution are clear. Surface finds avoid upland or extensively peat covered areas, explaining the scarcity of information from the north and west of the country. Much of this is of course mountainous, but more intensive research might be expected to recover more sites on the coasts and

islands. Ploughing appears to be a major factor in the discovery of surface finds. Even in areas that are predominantly pastoral (e.g. the upper parts of the major river valleys, such as the Dee and Tweed) some ploughing does occur on improved grassland and for fodder crops, and the distribution of artefacts follows the river valleys where ploughing is most likely. The monuments are much more prominent on the uplands than surface finds, and can be recognised even where vegetation and peat cover are unbroken. The Uists are a good example of this (figure 5.10), with chambered cairns extending down the whole length of the islands, mainly on inland areas with blanket peat, but polished stone axes are much rarer and restricted to the coast. Land has been lost to sea level rise in the islands and the Neolithic land surface is largely hidden under the machair, shell sand covering much of the west coast (Crawford and Switsur 1977), making the scarcity of surface finds unsurprising.

The south-west corner of Scotland also provides an example of funerary cairns concentrated largely on high ground. This has been contrasted with the more lowland distribution of cairns in other areas of Scotland (Hunt 1987, Childe 1934), and interpreted as representing a concentration of occupation on the uplands. The distribution of axes and leaf-shaped arrowheads recovered from the NMR for the south-west presents a purely coastal and riverine pattern common to the rest of Scotland (figure 5.11). The inverse relation between surface finds and monuments does suggest a greater loss of monuments from lowland areas than has been assumed (Hughes 1988), and this must be considered especially for arable areas such as the east of Scotland. It is also difficult to determine whether the axes are distributed on lowland because that is where early farms were located or because that is where present farming is restricted to. The absence of axes on the Pennines and North York Moors, despite the research there, may suggest that early farming was not particularly likely on the uplands, and that the cairns were somewhat removed from the settlement areas.

Though most of the arrowheads have a similar distribution to the axes it seems possible that this is the result of the small sample of arrowheads that could be identified as leaf-shaped. However, the representative nature of this sample can be tested, at least for eastern Scotland, as Hamilton (1983) searched local museums for flint arrowheads, and recovered a considerably larger number than appear in the NMR. The addition of Hamilton's arrowheads to the map (figure 5.12) produces little change in the distribution pattern. There are a few more located on higher ground, and it seems probable that the lowland distribution pattern is largely caused by the scarcity of research on the uplands.

At a regional level Neolithic Orkney has received a great deal of attention due to the quantity of impressive monuments and well preserved settlements on the islands. The

research effort expended on the Neolithic in Orkney "*would be hard to match elsewhere in the world of archaeology*" (Fraser 1983 p35). However, out of 54 excavations on early prehistoric sites by 1983 only 4 were on settlement sites, most being on chambered cairns (Fraser 1983). Despite the quantity of work on these cairns there is little dating evidence before 2500bc. The Knap of Howar settlement is early Neolithic, and several of the cairns are probably of this period also, but present knowledge is insufficient to identify these, or when social change occurred in Orkney, and which cairns are indicative of it (Fraser 1983).

Funerary monuments

The assumption that recent agricultural improvements alone may have determined the scarcity of cairns on fertile lowlands should not be accepted without some supporting evidence. While this does appear to have occurred in the Ythan valley, for example, similar distribution patterns in Ireland can be demonstrated not to be due purely to recent agriculture. Work by the Ordnance Survey in the 1830s and 1840s demonstrated that megalithic tombs²⁶ were found mainly on poorer soils before intensive improvement was widespread (Woodman 1992).

Most distribution studies of early Neolithic Scotland rely entirely on monuments (long cairns, long barrows and megalithic tombs) to define early Neolithic activity. They are highly visible, and fairly diagnostic of the period, though insufficient dating has been obtained to identify the age range for these monuments in Scotland. The scarcity of settlement sites prevents the relationship between settlement and tomb location from being understood. The tombs are usually located near areas considered to be favourable for habitation, indicating the relationship is fairly close (Hunt 1987). Soil types do not seem to be relevant to the use of chambered tombs, but often influence their location. This is probably due to their close association with settlement sites, which are located on fertile land. The relationship of tombs to fertile soil, their location in places that have easy access, and are visible from some distance indicates they were associated with everyday life rather than divorced from it (Fraser 1983).

However, a close relationship between settlement and tombs cannot be assumed throughout Scotland, and a scarcity of tombs cannot therefore be taken to represent an absence of Neolithic activity. The relationship does not seem to be demonstrated in Ayrshire. There is an absence of burial cairns on the lowlands of the Clyde valley, though

26. The terms "funerary monument" and "tomb" are used for convenience, though it is appreciated that not all sites commonly referred to as such contain evidence of burials. The function of these sites is of less importance to the present argument than their size and resilience.

there are numerous stone axes indicating that there was settlement there. Chambered cairns are fairly hard to destroy, and there are no records of their destruction in the past from areas of Ayrshire where they are absent today (Hughes 1988). The concentration of cairns on the uplands of Dumfries and Galloway, away from the bulk of the surface finds may also indicate a spatial separation between cairns and settlement, though, as mentioned above, the contrasting taphonomic factors confuse the interpretations.

Generally tomb distribution avoids uplands, but some upland and inland distributions exist. The presence of forest would make the uplands more sheltered and hospitable, but there are probably fewer cairns lost here than on the agricultural land in the valleys. In central and south-east Scotland there are sites at fairly high altitudes in the Lennox, Pentlands and Lammermuir Hills (Hunt 1987). In contrast to the normally coastal distribution of cairns in Scotland those in North Uist are located with no preference as regards the coast. Though sea level changes have been significant and some coastal cairns may have been lost, and peat and the reuse of stone have masked and confused cairns. The remaining evidence suggests considerable use of inland locations, and no emphasis towards the coast. Instead there seems to be some attempt to ensure intervisibility between cairns. South facing hill slopes are also preferred, but not used exclusively (Chrisp 1990).

Field work is patchy and it is unlikely that the full distribution of tombs is known, even without considering those that have been destroyed by human or natural processes. There are very few tombs along the west coast of mainland Scotland, and a very sparse spread of sites east of Nairn, which can best be accounted for by lack of research (Hunt 1987). The scarcity of sites on Harris and Lewis, is probably due to a lack of field work in the less accessible areas of the island, and because many of the sites are under peat. Earthen monuments may have survived less well than stone cairns, especially in heavily improved landscapes, and areas with few cairns, especially in the arable south-east of Scotland, may have originally possessed this type of monument.

There appears to be a strong coastal distribution of Neolithic sites round Scotland, though the reasons for this may be variable. In Orkney Fraser (1983) considers the coastal distribution to be related to the availability of building stone. In many areas they are located on the coastal plain or in river valleys, joined to the coast by the rivers (Hunt 1987, Henshall 1963). In some areas cairns seem to be related to free draining soils, suitable for early agriculture (Childe 1934, Fraser 1983). Often the cairns are located on the upland edge of the arable land, and overlooking it. Sites in highland areas are restricted to sheltered valleys with better land, but most fringe the alluvial of the valley floors (Hunt 1987). However, the discussion of sites in relation to soil types is difficult, as

not only have soils changed considerably since the Neolithic, but Neolithic people may have perceived the quality of the land differently than we do today (Davidson 1979). The absence of cairns from the lowlands of Ayr, the Lothians and the Carse of Forth, is probably due to their removal during agricultural improvements (Hunt 1987).

5.3 Conclusions

(figures 5.7, 5.8, 5.9, 5.13, 5.14)

The major conclusion of this chapter must be that most trends on the distribution maps are caused by post-depositional factors. There is no reliable way to quantify these, and it is often impossible to list all possible influences. Regions with moorlands and mountains may suffer most significantly from the effects of masking and inaccessibility, while lowlands areas suffer from the destruction of upstanding monuments. Where considerable work has been carried out, such as in southern England, more subtle problems, such as the identification of late Mesolithic and early Neolithic flint scatters become more obvious.

Though the majority of patterns seen across Great Britain are attributable to factors of survival and discovery, some trends may be more closely related to the original distribution. There is a concentration in both periods on river valleys, and the coast, particularly locally dry locations within these areas. Over all the distribution of sites of the two periods are similar, with the main exception of the early Neolithic avoidance of higher uplands, and the late Mesolithic avoidance of some downlands. There is a tendency in both periods for sites to be located on ecotones, the junctions between two or more ecological zones, where natural resources would be most varied (Gardiner and Shennan 1985, Tilley 1979). However, the significance of these relationships is far from clear. Some locational change would be expected with a reliance on agriculture, yet some continuity would also be expected whatever the nature of the change during the Transition. Important locational factors for settlements are likely to be similar whether a group has a hunter-gatherer or farming economy. Neither trend reveals much about the relationships between the cultures and economies found on these sites. Though the distribution patterns do suggest that almost wherever there were early Neolithic settlements there had been Mesolithic groups in the area previously or even simultaneously. It seems highly unlikely that the first farmers, native or incomers, in Britain could avoid contact with hunter-gatherer groups, though the poor chronological precision of the indicators used here prevents the location of the latest Mesolithic or earliest Neolithic groups to be identified.

The innumerable biases affecting the data make comparisons of the distribution patterns much more difficult than the distribution maps suggest. However, in well surveyed areas, such as south-east England, avoidance of late Mesolithic sites by early Neolithic ones, or significant differences in sites location, should have been revealed if they existed. In general, the shift in settlement location seems to be slight, with locally good agricultural land being favoured in the Neolithic, along with the development of what

appear to be ritual landscapes. Both could be explained by the introduction of a new economy and ritual system to the native population. It seems unlikely that an incoming population could cut across existing territories, and use local knowledge and resources so freely without causing hostilities, of which there is no archaeological evidence.

Coastal sites were of considerable importance in the Mesolithic, especially in areas with productive estuaries. The loss of coastal sites in many areas of England and Wales must have distorted Mesolithic evidence. In comparison with Denmark, Scandinavia and ethnographic parallels the coast might be expected to support the most sedentary Mesolithic groups. The loss of these sites may give the British Mesolithic an artificially mobile character. There is less emphasis on the coast in the Neolithic; marine resources may have been exploited, but settlement location seems to have been determined mainly by agricultural demands. Only in Wales is there a clear coastal distribution, though this may be largely an artefact of differential research. Marine exploitation clearly continued into the Neolithic in Scotland, where coastal sites are preserved.

Mesolithic and Neolithic site distributions are harder to compare for Scotland than most other parts of Britain, because of the scarcity of fieldwalking. What late Mesolithic sites are known imply a riverine and coastal pattern, similar to the rest of Britain, and it seems unlikely that the north of Scotland was uninhabited despite the few sites represented there. Early Neolithic settlement is also poorly represented because of the emphasis on standing monuments rather than artefact scatters. Settlement locations must be guessed at in relation to tombs and axe distributions. The following chapter is designed, not only to further study factors biasing distributions, but to attempt to contribute to the known distribution pattern. Discussing large regions does seem crude, masking detailed relationships between sites and their environment in generalisations. To explore this problem further the next chapter considers the site distributions in a single valley, where the data and biasing factors can be considered in considerable detail.

CHAPTER 6: THE TRANSITION FROM MESOLITHIC TO NEOLITHIC IN THE DEE VALLEY: A CASE STUDY

6.1 Introduction

The previous chapter studied national trends in early site distributions, and assessed the problems associated with this type of data. It relies heavily on other authors' assessments of the reliability of the data. To further investigate these problems the site distributions in a small area were studied. At such a local level it is possible to identify most factors influencing site distribution, and to achieve a better understanding of sites in their past and present environment.

The area chosen for study was the Dee valley, Grampian region, Scotland. Several factors determined this choice. Initially it was decided to concentrate on an area in Scotland. The south of England has received considerable attention in relation to the Transition. This is understandable, as the abundance of flint means the industries are less influenced by raw material type and availability, and so are easier to interpret. There are also numerous excavated sites to help establish the chronology of surface scatters. Despite these advantages the problems are far from solved. However, it was felt that comparative data from the north would be more valuable in investigating this problem nationally, than initiating another research project in the south. Comparison between Scottish evidence and that from southern England has potential for illuminating the problem, or at least suggesting new lines of enquiry.

Within Scotland important selection factors included: the existence of previous work in the area, preferably excavations as well as field walking; a well defined area, where natural boundaries defined the probable area of local exploitation; and the vertical distribution of resources allowing the study of exploitation of different environments. Work on the Transition in Scotland is minimal, but knowledge about Mesolithic and Neolithic site distribution is improving, especially in the west. The east has largely been neglected, but there is a large number of known sites, and considerable potential for synthesis and analysis. The Dee catchment forms a well defined area, with a wide range of environments and topography, giving the possibility to explore past activities in various landscapes. Not only are there several sites known through field walking, but also a few excavations. The potential of the valley for providing information on the Mesolithic and Neolithic periods, and possibly the transition between them, seems to be considerable, and so it was selected for this study (see figure 6.1 for location of the Dee valley).

The problems of archaeological research in Scotland have already been discussed, and these apply equally well to Grampian. It is more fortunate than some regions because it has a long history of amateur collectors, but there has still been considerable neglect from professional archaeologists. Callander noted in 1935 that *"although many extensive collections of relics have been gathered from the area, its antiquities, with the exception of two or three classes, have never been systematically described..."* (p69). The situation has changed very little today, the Dee valley being particularly typical of the problem.

The presence of significant Mesolithic activity in the Dee valley has been recognised since the publication in 1936 of Paterson's Banchory flint collection (Paterson and Lacaille 1936). Lacaille frequently mentioned this site in other publications, and local people continued the tradition of collection, especially round Banchory²⁷. One of the valley's long cairns was recorded in 1924 by Callander, and four are now identified. There is also a considerable number of Neolithic arrowheads and ground stone implements. Excavations relevant to these periods in the valley have not been numerous, but are of considerable importance. Near Banchory three excavations have been carried out: Balbridie, a Neolithic timber hall (Ralston 1982); Nethermills, a Mesolithic habitation site (Kenworthy 1981), and the small Mesolithic excavation at Birkwood (Paterson and Lacaille 1936). There are also three sites in Aberdeen, near the mouth of the Dee that produced *in situ* Mesolithic deposits: the Green, the Broad Street/Queen Street site, and Saint Paul's Street. Other excavations nearby produced Mesolithic material on the natural gravel, or redeposited in later layers (Kenworthy 1982, and Stones pers. comm.).

6.1.1 Physical background

6.1.1.1 Relief, climate and soils

The Dee is a fast flowing river about 85 miles long, which drains an area of 817 square miles (McConnochie 1895). Its valley and drainage basin cover a wide variety of relief; the highest point in the valley is the summit of Ben Macdui at 1309m OD (Gemmell 1975) (figure 6.3). The underlying geology is mainly acidic rocks, but this is largely covered by a considerable thickness of glacial drift (Gillen 1987). Fluvio-glacial deposits have formed distinctive features, such as the valley-side terraces of sand and gravel, and kettleholes (Sugden and Clapperton 1975). The latter have filled with water to become

27. See figure 6.2 for location of towns mentioned in the text.

small lakes, such as Lochs Davan and Kinord in the Howe of Cromar (Murdoch 1975). More recent deposits: alluvium, peat, raised beach deposits, and sand dunes, have further altered specific areas of the drainage basin. The uplifted Main Postglacial Shoreline can be traced to the north and south of Aberdeen (Walton 1963a).

The north-east of Scotland is a region of climatic extremes, but while highly variable, the climate is generally hospitable. The area has a high incidence of sun especially in winter, and the rain shadow effect of the Grampian mountains means the annual rainfall is lower than average for Britain (Stone 1987). There is considerable variation in climate between the east and west ends of the Dee valley, largely due to the difference in altitude. Rainfall generally increases with altitude, and the growing season is shorter inland (Glentworth 1963). Particular areas have localised microclimates. The Howe of Cromar (also called the Tarland Basin) is sheltered by the mountains, and has a higher than average number of mild days for Scotland (Edwards 1978). The coastal strip is subjected to sea mist in spring, and the hills cast a cold shadow over the south side of the valley (Walton 1963b).

Figures 6.4 and 6.5 present a simplified version of the distribution of present soil types and land capability in the valley. The quality of soils tends to vary with altitude and steepness of slope. Fertile, brown forest soils form on well-drained sites under deciduous forests, which includes most of the lower slopes of the Dee valley. Podzols tend to form on well-drained sites under pines, and now cover much of the upper valley and higher slopes. The soil of the Dee valley is stony and coarse, due to the glacial till on which it is based. Even the alluvial soils in the Dee valley are coarse, and subject to drought, making them less suitable for agriculture than those in the neighbouring Don valley (Glentworth 1963 and 1981). However, soil variation has been significantly accentuated by agriculture and erosion since the forests were felled. The soil types have been modified so extensively by agriculture, that it is hard to extrapolate them back into the past (Edwards 1978).

Cultivation at present rarely exceeds 300m, and generally stops at 240m OD. Most of the land below 150m is intensively, cultivated and entirely artificial (Dunnet 1963). Numerous hut circles up Glen Gairn indicate farming at higher altitudes in the past, presumably the Bronze Age. More recently barley was grown for whisky on the higher land (McConnochie 1895), and Shepherd and Ralston (1981) found evidence of settlement and farming up to 430m OD in Glenmuick and round Crathie. The Howe of Cromar forms an isolated area of good quality land; the soils have a high proportion of basic, igneous material, and on south facing slopes cultivation is possible at higher than normal altitudes (Soil Survey of Scotland 1982). Even here, the good soil forms only 25% of that in the basin, the rest being stony, and of lower fertility, though mostly free draining (Edwards 1978).

6.1.1.2 Vegetation and fauna

There are several pollen diagrams from the Dee valley, and a certain amount of work has been done in the north-east in general, indicating that the area comes within the pine-forest with birch and oak ecological region, though it is now mainly deforested. The mixed deciduous forests of zones VI and VIIA are the environment in which the Mesolithic people of the valley lived. The continued importance of birch and hazel in these forests suggest they were more open than those further south, and possibly more productive. Clearings for grazing animals may have been more frequent, and fruit-bearing undergrowth and hazelnuts plentiful (Edwards 1978).

The elm decline marks the start of zone VIIB. As elm was scarce in the area, this presumably represents a drop in the elm component of the regional pollen rain. However, some local clearance activity was occurring at this time. While the elm decline registers faintly in most of the diagrams, local clearance is not seen in all. Loch Davan and Braeroddach Loch show interference at the elm decline, but Loch Kinord does not, despite being only 1km south of Loch Davan. This might suggest that the former sites were located closer to Neolithic activity. Loch of Park, not far from Balbridie, has an increase in herbaceous pollen, and an in-wash of sand particles suggesting clearance and erosion around the elm decline (Gunson 1975).

The best dated, and most comprehensive of the Dee valley pollen diagrams are from Loch Davan and Braeroddach Loch near Aboyne; these also include charcoal and geochemical evidence (Edwards 1978). Loch Davan has 16 radiocarbon dates, and Braeroddach has 18. Despite the number of dates taken there is still a millennium between most of them, but they have enabled an estimate of accumulation rates to be calculated.

Clear and long lasting clearance does not occur at Loch Davan until an interpolated date of 3335 BP, and 2095 BP at Braeroddach, but both sites have evidence for earlier, small scale clearance. The first disturbance evidence of this sort occurs at Loch Davan, dated 5105 ± 85 BP (UB-2106), and Braeroddach at 5295 ± 155 BP (UB-2073). These dates are statistically inseparable, and though a general decline in arboreal pollen is involved, elm declines more than the other species. Both the dates and the decline in elm suggest that these events occurred during the early Neolithic. While the early clearance at Loch Davan covers only one pollen spectrum, with a recovery of arboreal pollen over the next two, that at Braeroddach lasts several spectra, possibly representing a period of about 750 years.

There is no increase in non-arboreal pollen as might be expected. There was also no significant increase in geochemical erosion indicators, or in the presence of micro-charcoal, associated with these events. This could indicate that the "clearance" episodes are natural, possibly caused by colder weather inhibiting both trees and undergrowth. However, all these factors would be consistent with coppicing and garden horticulture among the trees, as suggested by Göransson (1984). In this hypothesis, coppicing would prevent flowering, but few trees would actually be removed. Filtration of non-arboreal pollen from the air would be increased by the more numerous stems of the coppiced trees. A climatic cause seems to be ruled out by the fact that Loch Kinord does not show a decline in arboreal pollen. The evidence, therefore, seems to suggest that the clearings were anthropogenic.

The concentration of micro-charcoal did not increase above a background level until the occurrence of later, more extensive clearance activity, when erosion also started. However, there were some very early peaks in the charcoal which Edwards (1978) attributes to natural fires; one peak occurred at Braeroddach at about 9500 BP. It now seems rather premature to rule out human influence at this date considering the date of 8590 ± 95 BP for late Mesolithic activity at Kinloch, Rhum (Wickham-Jones 1990). Loch of Park has some evidence for Mesolithic vegetational interference, which is unsurprising considering the number of flint scatters in the area (Gunson 1975).

The preservation of some of the old forests, and the almost untouched nature of the high peaks gives some indication of past habitats and fauna in the valley (Watson 1981). However, most habitats have changed so dramatically, that it is difficult to extrapolate present population composition, and behaviour into the past (Chaplin 1975). The mountains would have supported small game species, e.g. mountain hare, and red deer in summer (Dunnet 1963). Forest edge deer hunting is often assumed in the Mesolithic, and early occupants of the Dee valley would not have to travel far to reach more open

woodland on the mountains. The acquisition of feathers from birds such as ptarmigan and the golden eagle, may also have encouraged people to make trips into the high mountains.

Moorlands would have existed during the Mesolithic. High level blanket bog at 300-600m OD started forming during the Boreal, and though by 6000-4000 BP pine trees grew in the Cairngorms to a height of 750-850m OD (Gunson 1975), there would still be a considerable area of moorland between the tree line and the highest peaks. By the Neolithic moorland indicators increase in pollen diagrams, suggesting climate, and possibly human interference, were causing moorland expansion (Moore 1973, 1988). There is no reason to assume that hunting ceased in the Neolithic, and wild faunal resources probably continued to be exploited. However, it is hard to compare the ancient moorlands to those that exist today as these are essentially artificial creations, on which unnaturally high densities of grouse and red deer are maintained (Dunnet 1963).

Most of the valley would have been forested, with pine and birch forests at higher altitudes, and mixed oak forest in the valley. These forests would have supported various game birds, and large woodland mammals, whose presence in Atlantic forests has been demonstrated elsewhere in Britain, but can only be assumed in the Dee valley. Species probably included elk, roe and red deer, aurochs, bear, wild boar, and fur bearing species such as beaver and pine martin (Dunnet 1963, Legge and Rowley-Conwy 1988). Red deer was *"one of the most important animals in prehistoric economy...almost ubiquitous in woodland, moorland, and even tundra"* (Rackham 1986 p39). In mountainous country ecological zones are distributed vertically instead of horizontally, and a wide variety of habitats occur in a small area. In these conditions red deer would probably only need to migrate within a limited area, but would be likely to aggregate in the shelter of the valley during the winter (Young 1987). This would make them considerably easier to hunt than the other deer species, which are likely to have occupied the valley (Chaplin 1975). Elk, though large, are essentially solitary, and roe deer normally live in very small groups (Legge and Rowley-Conwy 1988), and these species might be expected to be less economically important than red deer.

Local bird life may have been economically important in the Mesolithic, though exploitation cannot be demonstrated by the meagre archaeological record. Herons were numerous in Scotland before widespread drainage, and could have formed a useful food resource (Neill 1931). In the historic period they are known to have been caught using baited hooks (Clark 1948). The lochs and marshes would have support many wild ducks, swans and geese. 2300 greylag geese were recorded on Loch Kinord in October 1982, and mallard and other species overwinter there in fairly large numbers (Watson 1981).

Fish must also have been important. Pike, perch and eel are the only resident species in these lochs, but only eel is native (Marren 1984). Before the introduction of the pike, the eel population was presumably considerable. Brown trout can also be caught in many upland lochs. McConnochie (1895) records that the now drained Loch of Auchlossan, near Aboyne, contained plentiful eels, and was frequented by seagulls, ducks and swans. The Dee contained what may have been the most important resource for the Mesolithic inhabitants of the valley; migratory fish e.g. salmon, trout and eels. The migratory fish form a large, predictable food source that can be harvested, and stored to provide food for much of the year. There are no lochs or waterfalls along the course of the Dee below the Linn, and its current is swift, making it a particularly favourable river for salmon and trout (Harper 1922). McConnochie (1895) records that 50 salmon were caught in one day at a good pool on the Feugh, a tributary of the Dee. Though net fishing is now restricted to the estuary, this is purely to protect the interests of sport fishing, and nets were used as far up stream as Banchory. The fish travel upriver about May, but do so earlier if the temperatures are higher, and the weather favourable (Harper 1922). It is possible, therefore, that during the climatic optimum, when temperatures were slightly higher and storms fewer, the fish may have consistently travelled upstream earlier than today, and the fishing season may have been longer. In which case they could have been an important food source in early spring, when other resources were scarce.

The coast must also have been rich in resources. Sea-bird eggs would have been plentiful at Fowlsheugh, near Stonehaven, now one of the most populous cliffs between Berwick and Caithness (MacGregor 1959). Grey seals are common along the coast, and terns and shelduck breed on the sandy beaches, where they would be easy prey. Clams and razorshells live in the sand, useful for fishing, if not as a food source in their own right. Cockles can reach a density of 2-300 per m² in favourable areas. The numerous invertebrates support large numbers of waders in autumn and winter, and red grouse live in the heather at sea level. The Ythan supports a large number of shelduck, and a breeding population of 1500 pairs of eider duck (Dunnet 1963), and these birds may have been common in the Dee estuary before the construction of Aberdeen.

6.1.1.3 Forestry and Farming

The present appearance of Deeside is the result of relatively recent developments in forestry and agriculture. These are of considerable significance to this study, because they have dictated both what survives, and what is discovered of prehistoric remains. After AD 1600, commercial exploitation of Scots pine became significant, and

major inroads were made into the natural forest, but many acres of new woodland were also planted. Though woodland clearance meant the extension of farmland, and consequent damage to monuments, this early forestry was not in itself particularly damaging to the archaeology (Wood and Patrick 1982).

Tree planting had declined by 1866, but the creation of the Forestry Commission in 1919, led to a renewal of planting. This planting involved exotic species, modern ploughs and phosphate feeds allowed planting in areas previously too wet, stony or steep (Wood and Patrick 1982). This resulted in the loss to forestry ploughs of some archaeological sites that had been protected by the land's marginality. However, much of the woodland in the Dee valley is private, and some of it very old (Cumming 1987), so that loss has been less than other areas of the North East. Forestry ploughing is advantageous for archaeology, for the same reasons that it is destructive. It can reveal sites that would otherwise remain hidden under heather and grass, and in an area with little eroding peat, it is the only way to detect upland flint scatters.

The most significant changes in relation to surviving archaeology started with the agricultural improvements of the seventeenth century. Enclosure and improvement was encouraged by acts of parliament, and new techniques allowed the cultivation of land previously too wet or otherwise marginal. Marshlands and mosses were brought into cultivation for the first time, and improved fertilisation allowed expansion onto poorer hillsides. Some displaced peasants settled on the most marginal land, extending cultivation even further. Between 1807 and 1877 the tilled acreage in Kincardineshire increased by 70% (Wood and Patrick 1982 p33).

Subsoil ploughing, introduced in the early nineteenth century allowed more destruction of archaeological sites than before, and a great number of upstanding monuments must have been lost during the building of consumption dykes to clear the fields of stone (Wood and Patrick 1982). However, the majority of early sites in the Dee valley are surface scatters, or excavated sites originally located by surface finds or crop marks. Only upstanding monuments have been recognised on uncultivated land. While ploughing, especially on shallow soil, will destroy archaeological stratigraphy, without it the presence of most sites would not be known. Most surface scatters are from ploughed land; even sites on pasture fields, located by finds in molehills, are occasionally ploughed. Many fields in the valley are farmed on a seven course rotation, with four years of grass and three of crops (pers. comm. from the Dinnet Estate Office). This provides the possibility for future intensive fieldwalking of some sites under pasture.

6.2 Study of distribution patterns and lithic analysis

This study is divided into three main parts: site distribution, fieldwalking, and lithic analysis. The first formed a starting point, and general overview of the problem. The location and other details of all relevant sites in the valley were collected, and factors influencing site location were analysed. Once information on site location was amassed, the known distribution pattern could be tested by fieldwalking. This included: a deliberate attempt to find Neolithic flint scatters by walking areas near the long cairns, testing the strictly riverine nature of the Mesolithic distribution, and investigating sites far up the valley. This involved both opportunistic walking of individual fields by the author, and more organised, large scale fieldwalking with the aid of fellows of the Society of Antiquaries of Scotland, North East Section.

In southern England, the problem of defining, and identifying, the material culture of the late Mesolithic and early Neolithic has been much discussed, but is probably more acute in Scotland, with its inferior flint sources. Attempts to distinguish these cultures in England by analysing complete assemblages, rather than relying on diagnostic artefacts, seems to have had little success (Bradley 1987, Ford 1987a, Pitts 1978). In Scotland the problem is rarely discussed, and perhaps because of this, identifiable early Neolithic flint scatters are very rare. This study has therefore to rely largely on diagnostic artefacts to identify the periods during which sites were occupied. Some attempt to compare total assemblages in this specific area does seem desirable, even if the results cannot be generally applied. Analyses were carried out on the larger Dee valley flint scatters to investigate possible cultural indicators in the assemblages.

6.2.1 Site location and distribution

The catalogue of all probable early sites from the Dee valley (appendix IV) has been constructed mainly from the Regional Sites and Monuments Record, but other sources have made a significant contribution. The Sites and Monuments Record contained relatively few leaf-shaped arrowheads, but it was possible to correct this omission by drawing on Hamilton's unpublished data base (1983). Her MA dissertation involved searching museums for, and recording, leaf-shaped and barb-and-tanged arrowheads from eastern Scotland. Her record of these artefact types is therefore more complete than the Sites and Monuments Record.

Another important source has been local collectors. While most of Dr. Grieve's sites were listed in the Sites and Monuments Record, his notes (copy supplied by

Kenworthy) provided additional information on them. Derek Milne, of Aberdeen, has informed me of many sites not previously recorded. As his lithic collection and notes were in storage I have been unable to study them, but several of these sites were inspected to verify their existence. Other information came from other local informants, the few published articles on Deeside, particularly Kenworthy (1982), and *Discovery and Excavation in Scotland*.

Altitude, soil type etc. was obtained by the use of 1:25,000 OS maps and the Macaulay Institute 1:250,000 soil survey and land capability maps for Eastern Scotland. For more detailed information the 1:50,000 land capability maps, sheet numbers 37 and 45, and the 1:63,360 soil maps, sheets 66, 67 and 77, were used. Unfortunately maps at these scales were not available for the whole of the valley. The data suffers from varying degrees of inaccuracy. Some findspots can only be located approximately, and the soil maps do not reveal very local variations. The distance of sites from the Dee is measured approximately in a straight line.

In the catalogue flint scatters have been classified according to the diagnostic artefacts in them. An assemblage may be listed twice if it contains both Mesolithic and Neolithic artefacts. Where there are no diagnostic artefacts scatters are classed as with or without blade cores. Assemblages that have not been published, or inspected by myself, are grouped as "unknown". Leaf-shaped arrowheads found in flint scatters are listed separately from the rest of the material from the site, as well as being used to classify the site as Neolithic.

6.2.1.1 Dating problems

Previous surveys of the Dee valley (e.g. Shepherd 1987, Kenworthy 1975, Ralston 1984) have assumed all flint scatters to be Mesolithic. In this section it is assumed that microliths and microburins are diagnostic of the Mesolithic, and that only those scatters possessing these artefacts can be assumed to be at least partly caused by Mesolithic activity. Polished stone axes and leaf-shaped arrowheads are considered to be suggestive of the early Neolithic, though they are not restricted purely to the early Neolithic, as discussed above (p¹⁷²). Most flint scatters are the result of repeated occupation of a site, and finds cannot be assumed to be from the same period. The dating of long cairns to the earlier Neolithic is usually assumed, though there are relatively few dates from Scottish sites, and the full date range is probably not known. The nearest dated site to the valley is Dalladies, a long barrow not a cairn, which has two radiocarbon dates in the middle of the

third millennium bc²⁸. Other dates from Scottish long cairns are earlier, but they are mainly single dates, and unreliable e.g. Lochhill (Masters 1973) and Glenvoidean (Taylor and Marshall 1971, Marshall 1972). Balbridie, at least, proves that there was early Neolithic activity in the valley, its radiocarbon dates being some of the most reliable in Britain.

The long period of production of both polished axes and leaf-shaped arrowheads has been discussed in the previous chapter. Their use as chronological indicators is clearly limited when they represent a period of over 1500 years. Hamilton (1983) claims that ogival forms of arrowhead are mainly early, but there are very few of these from the Dee valley, so trends in their distribution cannot be identified. In England axes from certain sources are thought to be exclusively early e.g. group XVI (Vine 1982), but little work has been done on identifying the sources of Scottish axes, and the dates of relevant axe factories.

6.2.1.2 Distribution patterns

(Figures 6.6a, b and c, and 6.7a, b and c)

The distribution maps reveal certain trends in the location of known sites. Most obvious is the scarcity of material from the upper valley. Two polished stone axes are recorded from near Braemar, but no leaf-shaped arrowheads have been found west of Ballater. Occasional scatters of flints have been reported further west. Previous authors dealing with the distribution of early sites in the valley have indicated a strong concentration of flint scatter sites round Banchory, with rare findspots further upriver (Shepherd 1987, Kenworthy 1975, Edwards 1975, Ralston 1984). The additional information gained from local collectors and other sources indicates greater activity in the upper valley than previously suggested. Kenworthy (1975) assumes this activity is related to summer hunting on higher ground, though all the sites presently identified are in valley locations.

Figure 6.6 clearly shows the strongly riverine distribution of the flint scatters; the vast majority are located within 100m of the river bank. The authors mentioned above also discuss this riverine trend. Ralston (1984) has suggested that the river was used as an artery of communication up the forested valley. The excavations at Nethermills (M9),

28. The earlier date from this site was rejected by the excavator (Piggott 1973a), and might be considered anomalous or the result of the old wood effect (see appendix II, R 7).

Crathes, located close to the north bank of the Dee, have been interpreted as a base camp, dating to the late Mesolithic (Kenworthy 1981). Several of the scatters that are some distance from the Dee are located along one of its major tributaries, especially the Feugh; with flints coming from Heugh-head Farm (F19), Strachan, and on the Castlehill of Strachan (M16). The latter is a very small scatter, assumed by Dalwood (1987) to represent a single visit to the location. However, it is hard to determine how much material has been lost during the Medieval levelling of the mound's summit (Yeoman 1984).

There is a distinct concentration of scatters round Banchory and Crathes, and a smaller concentration at the mouth of the river. Mesolithic activity at the coast is demonstrated by the flint working floors, including occasional microliths, on the sandy flats at the mouth of the Denburn, found during excavations in Aberdeen (Kenworthy 1982). Middens on the Main Post-glacial Shoreline may be Mesolithic, as they are not known to have produced pottery of any sort. However, the one excavated at the Bay of Nigg (O1) produced no diagnostic finds (Simpson 1943).

The Neolithic monuments, being more prominent, attracted attention early on. Cloghill long cairn (N1) variously called Longcairn, and West Hatton, was mentioned in the Statistical Account 1793, demonstrating that it is not a consumption dyke, as these were not constructed until later (Callander 1924). Callander (1935) mentions other two long cairns, Balnagowan and Cloghill, and Kenworthy (1975) lists four. None of these have been excavated, but it might be suggested that these are of a similar date to other Scottish long cairns, i.e. from about 3000 bc.

The list of long cairns is probably incomplete, because of the lack of intensive fieldwork in the area since Henshall's surveys published in 1963. While the Cloghill long cairn has been thoroughly discussed by Callander (1924), Simpson (1943), and Henshall (1963), there is some confusion about the cairn, or cairns, at Balnagowan. Callander (1935) notes that there are two long cairns at Balnagowan, and Simpson (1943) also identifies two long cairns out of the enormous number of cairns in Balnagowan Wood (O12). Henshall's experience, perhaps, makes her opinion most reliable, and when she investigated the site the wood had been cleared, giving her a better view of the monuments. She dismisses even the most secure of Simpson's long cairns as a "*low mound of field gathered stones*" (p392). However, the Blue Cairn (N6), on the saddle between Craig Dhu and Balnagowan Hill, is a genuine long cairn, with a shallow forecourt between horns at the east end (Henshall 1963). Edwards (1975) identified the presence of another long cairn at Balnacraig (N7), not far from Balnagowan. Ogston (1931) reported the presence of two long cairns of "*considerable size*" on Wisdomhow (O13), but the SMR records that when

this was investigated only "*rocky glacial mounds...but no trace of cairns, or a ring of stones*" were found.

While the long cairns suggest the presence of some social complexity normally associated with the Neolithic, it is the Balbridie timber hall (N4), which truly indicates that the Neolithic of the Dee valley was not a simple, provincial version of that in southern England. Though not identical to the Linear Bandkeramik long houses, it is a "*sophisticated architectural achievement for any date*" (Ralston 1982 p238). Quantities of charred cereal grains indicate a farming economy, though the presence of hazelnuts implies that wild resources were also exploited. The dates have been discussed elsewhere, and there is little doubt that this structure is indeed Neolithic. The timber hall identified in aerial photographs at Crathes, across the river from Balbridie, differs in ground plan and length:breadth ratio to the Neolithic structure. Only excavation will show whether it too is Neolithic or post-Roman (Ralston 1984). There is also the cropmark of a pit alignment in the Crathes field which may be Neolithic. A large pit-defined enclosure excavated at Douglasmuir, Angus, was demonstrated to be Neolithic (Ralston 1984).

There are other cairns in the valley, but they are of types not usually classed as early Neolithic. The round cairn at East Finnercy, is probably of Bronze Age date; though sherds Neolithic pottery, Lyles Hill ware, was found during its excavation (N3). Most of the sherds came from the ground surface beneath the cairn, though some were in the soil between the cairn stones, presumably representing residual material which was incorporated in the cairn with the soil (Atkinson 1962 p18). Kenworthy (1975) assumes that the ring cairns are also late, though there is a date of 4935 ± 105 BP (2985 bc) GU-2014 for the construction of the ring cairn at Midtown of Pitglassie, where a leaf-shaped arrowhead was also discovered in a cremation pit (Shepherd unpub.). A single date, especially on charcoal as in this case, is highly spurious as dating evidence, but could possibly suggest a longer period of construction for these monuments than usually assumed.

Despite the numerous, probable Neolithic monuments in the Dee valley, Balbridie, the pottery from under East Finnercy barrow, and some early Neolithic pottery from a pit excavated at Park Quarry (N2), Durris, are the only indication of settlement. Scatters of arrowheads and axes show more ordinary activities must have been taking place, but no Neolithic flint scatters are claimed in the literature. Some of the arrowheads included in appendix IV were associated with flint scatters, and may indicate a Neolithic date for these. However, dating a flint scatter, which has probably been reoccupied several

times, by an arrowhead which may merely have been lost during hunting, is clearly insecure.

Polished axes and leaf-shaped arrowheads have been found in large numbers, but many belong to types that continued in use into the Bronze Age. Very few of these axes are made of flint, probably because the Buchan gravels do not contain large enough, flawless pebbles. Over 40 leaf-shaped arrowheads appear in appendix VI, and many more must be in private collections. These numbers suggest a greater density of Neolithic activity than implied by the small number of monuments, and scarcity of Neolithic pottery. This could indicate the continuation of use of leaf-shaped arrowheads after the Neolithic, however, the lack of pottery is largely due to poor preservation, and the small number of excavated sites. Early pottery has little chance of surviving intact in the plough soil. The arrowheads and axes are therefore the best indication of activity in the area throughout the Neolithic as a whole, but the identification of purely early Neolithic activity is problematic.

Like the flint scatters both axes and arrowheads seem to follow the course of the river, arrowheads perhaps more so than axes (figure 6.7). However, many are also distributed up larger tributaries, or even away from the larger streams. Axes are rare from the lower part of the river, and are absent from the stretch between Banchory and Park Bridge where flint scatters are particularly numerous, and arrowheads are quite common. There seems to be a discrete concentration of both classes of finds around Loch of Skene and in the Howe of Cromar.

Though Edwards (1978) claims that the early Neolithic occupation of the Howe of Cromar was widespread this is based only on the two long cairns, and a scatter of polished axes that could be as late as Bronze Age. Planoconvex knives and carved stone balls, generally assigned to the late Neolithic, are present in the Howe, while the only suggestion of early Neolithic activity are the long cairns. The dates from Balbridie show clear evidence of early Neolithic activity on Deeside, but it is hard to associated this with surface artefact finds.

In summary, the available published evidence suggests the concentration of Mesolithic settlement on the coast, and up the river as far as Banchory; with only scattered, presumably specialised activity, further up the valley. Early Neolithic people were certainly present, but it is hard to relate any evidence directly to them, except the long cairns and Balbridie. Later Neolithic and Bronze Age use of polished stone axes and leaf-shaped arrowheads masks evidence that could be gained from these, and no Neolithic flint scatters have yet been firmly identified. However, very little collecting has been recorded away from the river. The existence of two such collections, from Ferney Howe

(Z6) and Mains of Kinmundy (B2), is suggestive that searches in other areas may be productive. A small programme of fieldwalking was designed to test the riverine nature of the flint scatter distribution, and to attempt to locate early Neolithic flint scatters.

6.2.1.3 Fieldwalking

Surface finds can provide "*a good general overview of the distribution and extent of settlement, and other activities, over a wide geographical area*" (Gardiner 1987 p57). They can also provide important information on site distributions, which would otherwise be unavailable. One must always be conscious of the biases of surface collections. Objects collected on the surface are not necessarily typical of sub-surface deposits (Broadbent 1979), and identifying site function from surface collections can be difficult (Ford 1987b). Artefact density is often not simply related to ancient events, but is heavily influenced by recent events, such as ploughing, soil and weather conditions when field walking takes place, and even the experience of the field walking team (Phillips 1989). However, only a small proportion of the total finds in the plough soil is collected, so field walking results can be tested by walking the same field over several years. This should reveal general patterns in distribution, and genuine concentrations of finds (Tingle 1987). Studies suggest that lateral displacement of finds by ploughing on fairly flat sites is relatively small (Broadbent 1979), though on slopes movement of colluvium could cause considerable artefact migration and cause aggregations of finds that could be mistaken for sites (Ford 1987b). Ploughing mixes material of different ages together and identifying the date of all or part of a surface assemblage is problematic.

Ideally a test of existing distribution patterns would involve an extensive programme of field walking over a period of years. Fields need to be walked several times at different seasons and under different conditions, to maximise the representative nature of the collection. Once the location and size of scatters had been determined intensive, gridded collection would improve this further. Such a long-term approach is clearly beyond the scope of this study. Instead sample areas were tested, and it is hoped that the involvement of local people will encourage them to carry on the work. The emphasis was on testing the riverine distribution of the flint scatters, and identifying early Neolithic flint scatters.

To maximise the chance of locating early Neolithic scatters, fields in the vicinity of the long cairns were investigated. The relationship of long cairns to settlements is unclear, but these monuments are some distance from the river, and it was thought probable that they indicated more general Neolithic activity in these areas. Various

locations by the river were investigated to test the extent of activity along the river. Occasional other locations were investigated away from the river, where evidence of sites was reported by local people. The study was constrained not only by time, but also by the limited availability of ploughed land, and problems of identifying landowners, together ensuring that only a small number of fields could be walked.

Method

Though fieldwalking can be biased by many factors, and provides only generalised interpretations, it is the only way to acquire information on many types of site. Methodical fieldwalking allows relatively rapid surveys of large areas to be carried out with minimal equipment. The aim of this survey was to identify the presence of sites, often in locations with no previously recorded finds. This required a rapid survey, and finds need only be mapped approximately. Where sites were located subsequent, more intensive, walking may be applied to discover the precise location of artefacts, but speed was of more importance to this project than accuracy.

Initially the traverse and stint method (Liddle 1985) was used. This involves walking across a field and back at 10m intervals (traverses). The traverses are numbered and split into 30m divisions (stints), which are given letters. Finds are bagged with the relevant traverse and stint number. This provides fairly accurate locational information, but the time taken marking out traverses and stints was found to be excessive, especially when many fields produced very few finds. A more practical alternative was walking across the field in the same way, but with out marking traverses. The location of finds was estimated and marked on a map. This was very approximate, but perfectly adequate for the level of survey being undertaken, especially as most of the fields were small, and it was relatively easy to estimate find locations within them. Distances between traverses were generally 5-10m. This is much shorter than recommended by Liddle (1985), but is necessitated by the small size of some flint scatters; many of those previously identified by Grieve are c.20m in diameter.

Flint is not native in the valley, except on the coast, so all pieces must have been imported, and even unworked pieces were collected. The condition of the ploughsoil, especially its degree of weathering, and how recently it was ploughed, caused significant variation in the visibility of finds. Not all fields could be walked in ideal conditions as ploughing took place very late in some parts of the valley, leaving little time for fieldwalking before the crops are planted. However, there are no local stones resembling flint, so it was easily recognised, and under most conditions the fieldwalking team experienced no difficulty in spotting even very tiny pieces.

Early pottery does not survive well in the ploughsoil of Scotland. The aim was to collect any pre-modern pottery, but none was found. While it may be desirable to collect all surface finds, including modern ones, this was not done. This would have taken up time better spent in the search for finds relevant to the study. The artefacts once found would have to be washed and processed, but it seemed very unlikely that they would ever be studied. If studied, it is unlikely any useful information would result. Modern artefacts merely represent manuring of the fields over the last two centuries, which can easily be established from historical sources.

Quartz was not routinely collected, though it was probably used, in addition to flint, in both the Mesolithic and Neolithic. Identifying knapped quartz from plough-damaged or naturally broken pieces is difficult (Callahan 1987), and would have required considerable time expenditure, both in the field to collect all possibly worked pieces, and afterwards to identify them. The survey aimed to establish the presence or absence of prehistoric activity, and quartz was considered to be a poor indicator of this, and therefore not worth collecting. Where intensive, gridded fieldwalking is carried, and the intrasite distribution of quartz can be related to that of flint, its collection would be justified.

Results

Appendix I, note 6.1 summar^sies the fieldwalking carried out, and acknowledges those who helped at each occasion. Appendix V contains summaries of the assemblages collected, and illustrations of selected artefacts from these sites and others discussed in this chapter.

The Westhill group

Many polished axes have been found in this area, and around the Loch of Skene. The presence of the long cairn on the slopes of Cloghill suggests it may have been a focus for early Neolithic activity. The Stephens collection (B2.1), from Mains of Kinmundy, just east of Westhill, has numerous long blades, but there is no secure evidence for Mesolithic activity in the area. The area was identified as one in which, not only might flint scatters be found at some distance from the river, but that these may be early Neolithic in date with no contamination by Mesolithic technologies. A total of 11 fields were walked in this area, which accounted for most of the fields ploughed at the time.

The Mains of Kinmundy (B2.2) (figure 6.8) was investigated to identify exactly ^hwere the Stephens collection came from. Unfortunately only three fields on the farm were under-plough in 1992; one of which was being finished on the day the site was visited. As finds were unlikely to be visible this field was not considered to be worth walking. A sparse

scatter of flints was discovered in field 1; this seemed to be restricted to the north-east half of the field. This included a blade core and several blades, making it possible that the Stephens collection came from this field, though other fields obviously need to be inspected before this could be confirmed. A single flint fragment was found in field 2.

Three fields forming part of Borrowstone farm (Z2) (figure 6.9) were walked. Field 1 was particularly productive. 42 flints were recovered, including an invasively retouched point and a serrated piece. The finds were scattered round the edges of the field with a noticeable barren area in the middle of the field. This may be a post-depositional effect, but it is tempting to speculate that it is of some significance. Perhaps the barren area represents the occupational focus of the site, and the flint scatters represent rubbish disposal sites. Clearly only excavation could resolve this.

The flint scatter seemed to be fairly well defined, if large. It did not extend into field 2, except for a single fragment close to the road. However, it appears to extend into field 3. This had been recently ploughed, and small pieces were unlikely to be noticed. However, two cores were discovered, as well as a very fine leaf-shaped arrowhead. This could not have been used, as it was very thin (2mm), but unbroken; being shot from a bow would surely have resulted in some damage to the piece.

About 1km south-east of this site is the farm of West Hatton (Z1). Here 5 fields were walked (figure 6.10). Fields 1, 2 and 5 revealed a sparse scatter on gently sloping land immediately south of the farm. Finds in fields 3 and 4 suggested a denser scatter concentrated on a fairly steep terrace slope which crossed the fields. Though a few pieces, including a scraper, were on the more level terrace surface, most were on its south facing slope. This seemed too steep to be an occupation site, and the flints here may also represent rubbish disposal, with the occupation site on the terrace.

Borrowstone field 1 is 400m north of the Cloghill long cairn, and West Hatton field 4 is 700m to the south-east. Unfortunately the fields closest to the long cairn were under grass so a more direct spatial relationship between the cairn and flint scatters could not be established.

Braeroddach

(Figure 6.11)

Within the Howe of Cromar is a horseshoe of hills surrounding a small loch. Though most of the land is over 180m in altitude, it is south facing and sheltered. The altitude ensures that the land is above some of the frosts suffered by the Howe as cold air

drains in from the surrounding hills. The existence of a cairn field, and hut circles imply Bronze Age agriculture, and the numerous deserted, and ruined farmhouses suggest a considerable population in more recent times. The topography and alluvial deposits evident in the lower parts of many fields indicate that the loch was considerably larger in the past, and presumably provided important resources. The river Dee is c.2km south of the loch, and the larger lochs of Kinord and Davan are just over 3km to the west. Neolithic activity in the area is demonstrated by the two long cairns and palynological evidence for early Neolithic forest clearance from a core from the loch (Edwards 1978).

The long cairns, and the relatively habitable nature of the valley, would suggest this as an ideal location to search for early Neolithic settlement. Presumably it would also provide resources for hunter-gatherers, and is only about 3km from Dinnet, where microliths have been recorded.

Seven fields were walked in various parts of the Braeroddach drainage basin, both close to the loch, and further up the hillsides. This resulted in a total of 5 flints, 1 fragment from field 2, and the others from field 1, which contained the Balnacraig long cairn. Ploughing had taken place late, and few fields were sufficiently weathered to provide good conditions for spotting flints; however, this alone cannot account for the absence of finds. Most of the people involved had been on previous field walking trips, so inexperience of the team was not a factor. Several fields were walked in unpleasant rainy conditions, but those walked the following day in warm sunshine were no more productive.

While further work might reveal settlement activity, the fields sampled were representative of the various conditions in the Braeroddach catchment, and the results strongly suggest that there was no occupation here in the Neolithic, that is identifiable by the presence of surface finds. If this proves to be true it may be of some significance in determining the relationship between long cairns and settlement.

The river Dee

14 fields and other locations along the banks of the river were inspected, partially to investigate the sites reported by Derek Milne, and partly to test the concentration of sites near Banchory (figure 6.12). Most recorded sites are on the south bank at Banchory. Milne reported the discovery of flints on the north bank, in the graveyard (F17), the adjacent field, now covered with very scrubby lavender plants (F16), and along a footpath by the river (F14). There was no opportunity to search for flints in the graveyard, but a small number were found in the lavender field and the footpath, despite both having very little bare ground.

Near Crathes most of the flint scatters are on the north bank, but several sites have been reported on the south bank. Milne found flints on the flood plain at Wester Durris (F9), so it was decided to walk the fields there. Parts of four fields were walked (figure 6.13). A small area of field 1, on the first terrace, was walked with no success. The use of marked-out traverses and stints meant that more time was spent on this than seemed justified, so the rest of the field was abandoned, allowing time for other fields to be covered. Three flints were found in field 2 on the edges of the two upper terraces. No finds were made in field 4. Only a small area had been ploughed, and that was poorly weathered. Field 3 was directly opposite the Nethermills site, and located on the edge of the second terrace. 9 flints were found in the western half of the field (F10).

West of Banchory there is less ploughed land, and few reported flint scatters. 3 fields near Kincardine O'Neil were investigated (figure 6.14). One on the alluvium of the lower terrace near Potarch produced a single flint, that had been water-worn, and possibly washed downstream. Two fields were located on the fluvio-glacial upper terrace, close to the river (Borrowstone House and Heugh-head), and again were unproductive; only one flint coming from Heugh-head. In all cases soil conditions were fairly good, though there was some problems with snow obscuring parts of some fields. Fields were chosen purely because they were ploughed, and in suitable locations.

Much further upstream the only reported sites are those discovered by Derek Milne while fishing. Those furthest up stream, at Corriemulzie (F27) and Invercauld Bridge (F26), near Braemar, were inspected, but no flints were found. This was not surprising as the finds originally came from molehills and tree-throws, and the chance of finding more items on a single visit was fairly small. Further west than Ballater methodical fieldwalking is almost impossible, because the land is mainly used for rough grazing, with a considerable section of the valley floor under pinewoods. Molehills and tree throws are rarely dense enough to give a good coverage of the area, and sites are identified very much by chance.

However, there is a small area of arable land on the Balmoral estate, at Invergelder (B13) (figure 6.15). Milne reported scatters of flints along the lower terrace there, and one field was ploughed, and available for fieldwalking. The Invergelder field was in good condition; it had been ploughed over three months before the fieldwalking took place, and so was well weathered. Fieldwalking revealed nothing in most of the field, but a scatter of flints was found on the lower terrace, about 100m from the river. The area immediately round the scatter was intensively walked to establish the size of the scatter, and recover as many pieces as possible. It proved to be small, c.10 by 16m, but fairly dense.

While the coverage of the valley west of Banchory has been far from adequate, the fieldwalking may be taken to suggest that flint scatters do occur in the upper valley, but it also implies that they are less densely distributed than they seem to be round Banchory and Crathes.

In addition more *ad hoc* investigations were carried out in other areas. The field at Crathes castle containing the timber hall and pit alignment was walked, but with no success. The soil had been rolled in preparation for grass seed, and visibility of material on the surface was poor. A field was walked near the Castle Hill of Strachan (figure 6.16), which was located close to the river, and covering a small area of flood plain as well as fluvio-glacial terraces. Only two flints were found, and these were found in close proximity on the flood plain.

The possible presence of flint scatters near Upper Ruthven (B10) (figure 6.17) was suggested by Graham Steele of the Society of Antiquaries of Scotland. Fieldwalking of the field immediately north of the farm produced a quantity of flints, including cores and scrapers, which were scattered over all the field, but particularly concentrated in the south-east corner. The presence of flints in the field to the south was reported to Steele, but this field was under grass. The present owner of the farmhouse (Patrick Heron) has walked other fields in the area, and has found that the main scatter extends into the field to the east. Occasional other finds were recovered elsewhere around the farm. The collection from Ferney Howe (Z6) probably came from a similar area.

A small field at Ettrick Croft (Z7) (figure 6.18), near Dinnet, was walked after the presence of flints there was reported by Ann Keiller Greig of Ballater. This produced a small number of pieces, including two fragments of blade cores. The farmer had a collection which he had built up over some years, mainly from the lower part of the same field, where there is a slight plateau. Included in this collection was a leaf-shaped arrowhead.

6.2.1.4 Locational factors

It was initially intended to study numerous locational factors as was done by Kvamme and Jochim (1989) for German Mesolithic sites. The location of almost all sites on relatively flat, lowland areas made the consideration of variables such as slope, aspect and shelter volume, largely irrelevant. The following study is necessarily simplified, limited by the biases of the data.

Location relative to the Dee	% north	% south
Axes	84	16
Arrowheads	80	20
Flint scatters	59	41

Polished axes and leaf-shaped arrowheads are predominantly distributed to the north of the Dee, while the distribution of flint scatters is more even. The proportion of arrowheads south of the river is slightly greater than that of axes, very tentatively suggesting there was more hunting than domestic activity here. However, evidence for domestic sites is rare, other than the unsubstantiated assumption that they are represented by the axe distribution. Pottery, from under the East Finnercy barrow (N3), and from Park Quarry (N2), represents the only possible domestic sites, other than Balbridie (N4). Two of these three sites are south of the river, and located very close to it.

The north side of the valley would appear to be more favourable to agriculture than south of the river. It receives more sunshine, being out of the shadow of the Mounth (Walton 1963), and has a larger area of fertile land. The north side of the river is particularly favourable for agriculture towards the mouth of the valley, being generally lower, and less hilly than the south. The Howe of Cromar provides another, fairly flat, low-lying and fertile area, again attracting farming settlements north of the river. It is suggested that the first farmers in the valley occupied these most favourable areas north of the river, and it was only when the population density had increased by the early Bronze Age that more extensive exploitation of the landscape occurred. However, as many of the axes and arrowheads may be late Neolithic, it is difficult to identify which specific locations within this general area were used by the first farmers in the valley.

The majority of flint scatters are less than 50m above the level of the river, and less than 2km away from it (figure 6.19). The small number that are further from the river, but still less than 50m above it are located on major tributaries, and are actually in very similar locations to the majority. The exceptions are notable in that many include leaf-shaped arrowheads in their assemblages, and some are close to long cairns. The axes and arrowheads are much more widely spread, though there is still a concentration close to the river. Arrowheads might be expected to be widely distributed if they were lost on hunting trips, but the axes demonstrate a use of the majority of fertile areas, not just those closest to the river.

Occasional axes and arrowheads have been found on land that is agriculturally poor (class 5 and above), but the majority lie on soil with a capability rating of 3.2 (figure 6.20). This is land of average productive capability, now considered suitable for cereals and pasture. This covers the largest area of the lower valley, so most sites would be expected to lie on it, even if the distribution were random. Flint scatters are similarly distributed, with most on good land (class 4 and below), but occasional finds on poor land (class 5 and above). Class 4 soils are poorly represented, mainly because they only cover a small area in the valley. The only trend in relation to land use capability that may, possibly, be related to the original distribution pattern is the number of axes on class 3.1 soils. These soils only cover a small section of the valley (figure 6.5), and very few sites in other groups are found on them. Though this may suggest the close association of axes with agricultural activity, and the deliberate choice of fertile soils, the restriction of sites to ploughed land means that the full distribution of sites in relation to land use capability cannot be determined. A small proportion of sites are from urban locations, for which there is no soil information, or are so poorly provenanced that they cannot be associated with one soil type.

Sub-soil type	% on alluvium	% on till	% fluvio glacial
Arrowheads	21	46	33
Axes	27	55	18
Flint scatters	47	25	28

Clearer differences are seen in the subsoil types that the sites are located on. Sites on each subsoil are presented as a percentage of all sites in that artefact class, which could be provenanced to a single subsoil type. The majority of flint scatters were on alluvial deposits, axes were predominantly on till, and arrowheads were more evenly distributed, but with a bias towards the till. As till subsoils cover most of the lower part of the valley it is unsurprising that more sites are located on these than other subsoils (figure 6.4). In contrast most flint scatters lie on the much smaller area of alluvium and fluvio-glacial deposits. Both these subsoils are restricted to the river and its tributaries, the proximity of the river probably being the significant factor, not the subsoil type.

Survival and discovery

The observed distribution can be explained largely by factors influencing the survival and discovery of the sites. The close relationship between most classes of sites and agricultural land is highly significant. Figure 6.5 shows the scarcity of good land in the upper valley. Land capability classes 5.2 to 7 are land suited only to grassland and rough grazing, and so are unlikely ever to be ploughed, except for pre-afforestation ploughing. The scarcity of sites from these soils emphasises the importance of ploughing in site location, and explains the concentration of sites in the lower valley, and off high ground. Very little attention has been paid to the possibility of sites occurring in the upper Dee valley, and the land is generally poorer, with more permanent pasture, forests, and moorland. Flint scatters from the upper valley were found only in molehills and roots of fallen trees, even large axes are unlikely to be found in these conditions if they are not deliberately searched for. However, Milne's sites, as far up the valley as Braemar, suggest that a systematic survey of the river banks could reveal a significant number of sites. The uplands are highly unfavourable to artefact discovery, though it might be expected that pre-afforestation ploughing would occasionally reveal finds. Unfortunately none of this ploughing was known to be occurring during the present survey. Apart from the arable land of the valley bottom, nowhere in the Dee valley has suitable conditions, or undergone sufficient fieldwork, for any conclusions to be drawn about find distributions.

The long barrows are an obvious exception to the lowland distribution. While ploughing increases the chance of small artefacts being found, and agricultural land can reveal sites through crop marks, upstanding monuments are often severely damaged by agriculture. The loss of cairns through stone clearance in fields cannot be known; few of the 100 cairns known to have existed in the Ythan valley survive today (Ralston pers. comm.). The Balnacraig and Cloghill cairns are on land used in rotation for arable crops and grass, and though they have been robbed to build field walls they are still of considerable size.

The apparent clustering of sites seen on the distribution maps is problematic. Ploughed land is concentrated along the river, round Loch of Skene, and in the Howe of Cromar; exactly the areas where find concentrations occur. Much of the east end of the valley is built-up, and finds are rare without excavation. The concentration of Neolithic finds to the north of the river is probably of significance. While there is probably less ploughed land south of the river, the quantity of flint scatters, and intensity of collection south of the river, suggests that the relative scarcity of Neolithic findspots there is genuine. The lack of intensive field walking over most of the valley means that most other patterns are likely to be artefacts of differential discovery. Hamilton's (1983) catalogue of 1900

leaf-shaped arrowheads represents only 1.27 being deposited per year, considering this artefact type was probably produced over a period of about 1500 years. Presumably the discard rate must actually have been much higher than this, and the arrowheads recovered represent only a tiny fraction of those originally deposited. It is unlikely that this small proportion is truly representative of the real distribution pattern.

Much of the distribution pattern must have been influenced by the activity of collectors. It has been mentioned previously that collectors generally concentrate on locations close to their homes. Paterson, Grieve and Milne all lived in Banchory. William Anderson, the collector of the Ferney Howe assemblage (Z6) lived at the house of that name. It is not known if Charles Stephens lived at Mains of Kinmundy (B2.1), but this would seem likely. The only exception to this are Milne's inspections of the river bank further up stream, which he carried out while fishing. Until my own work no collecting had been carried out with the intention of testing distributions. Collectors are generally more interested in acquiring good material, and frequent locations where the possibility of finding material is high. In this respect all collectors after Paterson have been heavily influenced by her finds at Banchory. The excavations at Balbridie and Crathes served to reinforce the idea of the river being the best location to find early artefacts. The presence of the town makes the area round Banchory highly accessible to many people. Even school children, who would have little opportunity to explore more distant sites, could find flints in the Lavender Field (Milne pers. comm.).

6.2.1.5 Discussion

Though most of the sites on the distribution maps are findspots of lithic artefacts they represent various types of human activity. The flint scatters represent occupation of a site, at least long enough for knapping to take place, and probably other activities were carried out at most sites. Their location would therefore be determined by the demands of these activities, and some hope may be entertained that factors determining location might be identified. The Neolithic sites are mainly represented by single artefacts. In some cases these were related to flint scatters, and probable occupation, but for most their relationship to contemporary settlements is not known. An unknown number of arrowheads must have been lost during hunting, possibly some distance from areas where most activity took place. A close relationship between axes and settlement is claimed by various writers, and has been discussed in the previous chapter (p¹⁷³7). The similarity in distribution of both diagnostic Neolithic artefacts suggests they represent the area in which most settlement was concentrated.

If the occurrence of Neolithic finds is taken to represent the zone in which surface finds are likely, the distribution of flint scatters can be seen to be highly restricted. The likelihood of flint scatters being preserved and brought to the soil surface by ploughing is much the same as for individual arrowheads or axes. However, the chance of them being discovered and recorded may be significantly different. Many farmers in the valley are aware that flint is special, but finely worked arrowheads are more likely to be collected than unretouched flakes, and certainly more likely to be reported to the regional archaeologist or a museum. It is impossible to know how many of the arrowheads were single finds, and how many had associated flint scatters. Most of the scatters were discovered due to deliberate searches by individuals interested in prehistoric artefacts. Most of those found by 'accident' were discovered during excavations of later sites. It therefore seems probable that factors influencing collectors' decisions of where to look are significant in biasing the distribution pattern. The fieldwalking project carried out for this study supports this, with the discovery of 4 sites at some distance from the river, in addition to the two collections previously known.

While further work will probably reveal many more flint scatters away from the river, it does not necessarily mean that the riverine pattern is not significant. The scatters tend to fall into two groups. Most of Grieve's scatters are described as being discrete, and small in size. Even at the larger sites of Grieve A (M10) and C (M8) the flints are concentrated in specific parts of a field. This pattern was very clear at Invergelder, with finds only coming from a very small area, and none elsewhere in the field. Upper Ruthven (B10), Mains of Kinmundy (B2), Borrowstone (Z2) and West Hatton (Z1) present a different pattern. Scatters were large and dispersed, spreading over the whole of one or more fields. The presence of blades and blade cores does not fit this division well. Most sites have at least a small number of these. All the Grieve sites, excepting Grieve H (M5), have more blade than flake cores. The other sites have produced inadequate numbers of cores to determine their proportions within the total population. However, Borrowstone and West Hatton are notable for lacking blade cores, and having very few blades. Blades and blade cores are more prominent at Mains of Kinmundy and Upper Ruthven. Assemblages from all locations have a low number of splintered pieces, though small removals on the apex of many cores could indicate much more frequent use of bipolar knapping. Much larger collections are needed from the sites away from the river before the nature of their assemblages can be adequately described and compared, though it is probable that blade production continued into the Neolithic, and core types are of little use in defining Mesolithic and early Neolithic assemblages.

The distribution of diagnostic artefacts is of greater significance. Microliths and microburins are entirely restricted to the river. This must in part be due to the concentration of intensive collecting activity there, but none were found in other locations during this study, despite regularly recovering small pieces of flint. Invasively retouched pieces from Borrowstone, Ettrick Croft, Ferney Howe and West Hatton suggest a Neolithic date for at least some of the activity on these sites. The polished stone knife fragment from Ferney Howe, and the possible spearhead from Mains of Kinmundy imply some later Neolithic activity. There are numerous Bronze Age round barrows near Ferney Howe and Upper Ruthven making a Bronze Age date for these scatters possible, though the blade cores from the latter location might suggest otherwise. Despite demonstrating that flint scatters are to be found away from the river, this study has been unable to demonstrate the existence of Mesolithic activity more than 1km from the Dee or one of its major tributaries.

Figure 6.7 shows that the relationship between Neolithic surface finds and monuments or pottery is variable. The numerous axes and arrowheads from around the Loch of Skene and Westhill can be associated with the Cloghill long cairn and East Finnercy pottery. There are several leaf-shaped arrowheads from the vicinity of Balbridie, but the other long cairns, and the Park Quarry pottery, does not seem to be closely related to finds of either arrowheads or axes. In the Howe of Cromar these finds are restricted to the low-lying land near the streams, whereas the cairns are on low hills. Fieldwalking at Braeroddach suggested a lack of settlement in the catchment, and the probability that the cairns were isolated from everyday activity. Similarly there are no finds close to the Finzean long cairn, though the altitude of the site has restricted recent agricultural activity, making the discovery of finds unlikely. A prehistoric presence is demonstrated in the valley of the Feugh by one presumably Mesolithic scatter (M16) and an undiagnostic scatter (F19), which is as likely to be contemporary with the cairn as earlier (figure 6.16).

The lack of flint scatters in the Braeroddach catchment was particularly surprising considering the palynological evidence for early Neolithic clearance there. The small size and sheltered nature of the loch suggests that the pollen recorded was almost entirely from the loch's drainage basin, with little regional pollen rain. More work is necessary to demonstrate the absence of settlement in the valley, but if this is so it suggests the clearances were related to the construction of the cairns. The clearance indicators could demonstrate that the area round a long cairns was indeed kept open to allow the monuments to be visible, as suggested by ^{Fleming (1973)} Ø. The long duration claimed for the clearance episode could indicate a long period of use of for these monuments, or perhaps their use in succession.

Cairn location

(figure 6.7c)

All four long cairns identified in the valley are located in situations with impressive views, but these views are limited to possibly significant degrees. Excepting Finzean (N5), the cairns are not located on top of the local high point, even when this would be very easily achieved. Location on a high point would provide an all-round view, and this seems not to have been desired. The view from Finzean is limited by higher hills to the west and east, though location on a local prominence allows the view to both north and south to be seen. Considering evidence from Orkney and North Uist (Chrisp 1990, Davidson 1979, Fraser 1983), that intervisibility seems to be of some significance for chambered tombs, it is notable that none of the cairns can be seen from any other. This is most significant for the Braeroddach cairns as they are little over 1km apart and are only not intervisible because Balnagowan (N6) is situated slightly to the east of the watershed of an almost flat coll (figure 6.11). The location of Balnagowan is particularly interesting. The col provides no natural restriction to the cairn's location, so its location would seem to be deliberately chosen. Not only is the cairn invisible from Balnacraig (N7), but it is orientated roughly east/west and appears to be aligned to point at Morven, a prominent hill in the area. It also looks out along a fairly limited sight-line to the hills to the west. When visited on a still day it was noticed that there is an echo when standing at the cairn, and a normal speaking voice can be heard with particular clarity. This acoustic quality must be quite rare, and yet would surely be useful if the cairn were a meeting place as some authors have suggested for other monumental tombs (Fleming 1972b, Kinnes 1975, Malmer 1984).

The relationship of the long cairns to fertile soils may be significant. Cloghill long cairn is situated towards the top edge of land at present under cultivation. The two long cairns in the Braeroddach drainage basin are located on the south side of well drained, higher land. Though Balnagowan is just above present arable cultivation, Balnacraig actually stands in an arable field, and the land round both was probably suitable for cultivation in the past. The location is ideal for early agriculture: the drainage is good, the south facing slope receives the sun, the natural vegetation was probably light birch woodland, and the land is above the cold air that drains into the basin, so perhaps suffering from fewer frosts. Despite the favourable location there was no evidence of settlement in the basin recovered by fieldwalking, and more work is clearly needed before it can be determined whether the differences or similarities between the Braeroddach cairns and the Cloghill one are most significant.

River terraces

Many of the flint scatters are located on either the fluvio-glacial deposits or alluvial river terraces, which run along the banks of the Dee. Terraced deposits are a distinctive feature of the Dee valley, as they are of many river valleys in eastern Scotland (Aiken 1991). The terraces cannot be seen down the whole length of the river, but are particularly clear near Banchory, and just west of Aboyne. In the latter location six terraces have been recognised, most composed of sands and gravel, and produced by fluvio-glacial action. These tend to be undulating, with have a steep escarpment down to the next terrace. Close to the river are one or more flat terraces, and composed of water-lain sand, which appear to be fluvial in origin. The absence of glacial influence on these lower terraces suggests they were formed during the Holocene (Maizels and Aiken 1991).

There has been some discussion among geologists about the age of Holocene river terraces. Burrin and Scaife (1988) believe clearance and erosion caused by human activities were most important in causing alluvation, and therefore almost all major alluvations occurred after the Neolithic. Macklin and Lewin (1989) suggest climate was equally as important, especially early in the Holocene, when some alluvation appears to have occurred in northern Britain. There is also evidence from Sussex of alluvation from 10,000 BP, throughout the Atlantic period (Scaife and Burrin 1985), and Maizels and Aiken (1991) do suggest that one of the flat, lower terraces near Aboyne may be late glacial in date. Haley (1990) assumes scatters on the fluvial terrace at Rink Farm, in the Tweed valley, are not *in situ*, largely because of the later dates for these deposits in other parts of Britain. In the Dee valley several flint scatters are located on the lower terrace. It is important to assess whether these are *in situ* or not, before they can be used to define the Mesolithic site distribution pattern.

In Lacaille's small excavation on the lower terrace at Birkwood (M12), Mesolithic artefacts were found distributed in the upper 25cm of the alluvial sand. Small fragments of charcoal were found in the sand at the level of the flints (Paterson and Lacaille 1936). There was no well defined occupation layer, but flint and charcoal can easily move through sand, so the variance in vertical distribution does not necessarily mean the site is not *in situ*. It seems unlikely that the charcoal would have survived, and remained in association with the flints if these had been redeposited by the river. Though not conclusive, it seems more likely that the material on this site is *in situ*, rather than having been washed downstream. Grieve J (M11) is essentially the same site, on the lower terrace at Birkwood. The field which had not been ploughed for over 50 years when Paterson was collecting, but was ploughed in 1974, allowing Grieve to assess the full extent

of the site. It was small and well-defined, with few other finds in the field, further suggesting that the finds are *in situ*.

Firmer evidence is provided by the excavation at Nethermills (M9). This site is located on the second fluvial terrace (Kenworthy 1981), which at this point is ca.300m wide and flat. The description he gives of the subsoil is very similar to the sequence of water-lain sand, then fluvio-glacial gravels, seen on the lower terrace at the Birkwood site. The hut was obviously *in situ*, and constructed on top of the bulk of the alluvial deposits. It, therefore, seems that considerable alluviation occurred in the Dee valley in the early Holocene, and the lower terrace had already formed by the late Mesolithic. There has been little research into the date of Scottish river terraces, but three alluvial units have been dated from northern Britain to between 8400 and 4800 BP. It would seem that, irrespective of dating evidence from southern British rivers, alluviation did occur in the early Holocene in the north, at least in the Dee valley. This is significant because the flint scatters on the lower terrace can be considered to be *in situ*, and not the result of fluvial redeposition of material from sites elsewhere. Occasional sites have been identified on the present flood plain, e.g. Wester Durris 1 (F9) and Corriemulzie (F27); it seems probable that these have been redeposited.

From Banchory to the sea

(Figure 6.6c)

Though a study of the distribution patterns is rendered invalid over most of the valley by variations in preservation and research, it may be possible to consider a small area in detail. Most of the intensive field walking, and all the excavation in the valley has occurred close to the river between Banchory and the river mouth. The soil types are fairly uniform, and much of the land is ploughed, at least occasionally. A considerable area of land is built over, masking an unknown number of sites, but recent development in the city has enabled excavations to take place, and the accessibility of the area to a considerable number of people has encouraged intensive field walking.

It is highly unlikely that all existing flint scatters have been identified on the lower Dee, but there is an indication of a difference in size and frequency between the Banchory/Crathes sites, and those downstream. East of the Feugh, sites are frequent on both sides of the river. Grieve G (B7) and J (M11) are discrete sites, as that on the upper terrace at Birkwood appears to be. It is impossible to tell whether the scatters found in the graveyard (F17) and Lavender Field (F16), which are also said to have extended under the present Norco supermarket, are several discrete scatters or one generalised spread (figure

6.12). In either case it appears that the area was repeatedly occupied in the Mesolithic. At Crathes, the three centres of concentration of the Grieve C site (M8) also suggest reoccupation. The hut (M9) excavated here represents a relatively substantial structure, about 5m across (Kenworthy 1981. Not far away is the large site of Grieve A (M10), with Grieve F (B6) a little further up the river. This last site was only inspected twice by Grieve, so its size is not known. The slight scatter of finds on the south bank opposite Grieve C suggests some activity south of the river too.

Sites downriver are generally smaller, and less frequent. There are 2 small sites at Park (B5 and M6), and a scatter of others further downstream, but there seems to be no real concentration again until the mouth of the river. Grieve seems to have walked the north bank quite thoroughly, at least as far as Park. He believed that there had been a lake between Durris Bridge and Park Bridge because he found no sites there, despite extensive searching. There are sites from the south bank in this area, showing that Grieve's discoveries were not exhaustive, but Derek Milne, who has been collecting material in the area for a longer period than Grieve, could add only a few small sites to those found by Grieve on the lower stretches of the river (F8, F9, F12, F13).

Knowledge of Mesolithic activity near the mouth of the river is due entirely to rescue excavations carried out between 1973 and 1981 (Murray 1982), and in 1992 (Stones pers. comm.). The location of trenches was dictated by the developers, and the excavations were intended mainly to investigate Medieval deposits. Despite not deliberately searching for early activity, early artefacts and *in situ* deposits were found in four different areas (M1, M2, M3, M4, F1, F2, F3). Though a barb and tanged arrowhead was found on the Broad Street site (M1), no recognisably Neolithic material was discovered. Finds of occasional microliths suggest that much of the activity dated to the late Mesolithic, though the sites seem to be much smaller than those near Banchory. Less than 300 flints were found on the most prolific site despite full excavation, compared to 4000 from Grieve C, from surface collection alone.

Again an extensive programme of field walking is required to test the existing distribution pattern, along with further excavation in the city, but tentative conclusions can be drawn. The present evidence, from the lower Dee, suggests that the Banchory/Crathes area was the focus of early activity, especially Mesolithic, and other locations downstream were occupied on a more temporary or less frequent basis. It is tempting to see the sites at the river mouth as specific task sites. While there was no economic evidence recovered that might suggest exploitation of coastal resources, there was clearly flint knapping being

carried out on the sites, and the beach would be the closest source of flint for inhabitants of the valley.

On the present evidence, closeness to the Dee seems to be an important factor in the location of flint scatters. Neolithic activity may have been concentrated there because of the fertile alluvium. The importance of the river to the Mesolithic groups has been suggested to be as a transport route through, presumably, dense forest (Ralston 1984). Anthropological evidence suggests that the availability of salmon and trout may have been more important. Salmon has provided a reliable and abundant food resource, enabling at least semi-permanent settlements, in various hunter-gatherer cultures. Only excavation can suggest how large and permanent the settlements were, but the quantity of flint round Banchory and Crathes suggests a concentration of activity over time. The Dee as a whole is a renowned salmon river, but it may not be coincidence that last century Banchory was considered the highest point at which net fishing was profitable (Harper 1922). The reputation of the Feugh as a particularly good salmon stream may also be significant. The suitability of the area for catching salmon would seem to be an adequate explanation for the concentration of Mesolithic activity here. With the abundance of resources, especially with the predictable and storable salmon, year round occupation of a site near Banchory should have been possible.

An economy based on salmon requires some degree of social organisation to enable the fish to be harvested and processed within a limited time. The need for efficiency can encourage the development of central control, stimulate technical development and task specialisation, which may lead to increased social differentiation (Deith 1989). Unfortunately it may be impossible to determine what role a salmon based economy played in the development of the society that built Balbridie, especially as there is only circumstantial evidence to suggest the Mesolithic groups in the area exploited salmon.

Perhaps seasonal movement up and down the valley was more likely than sedentary settlement in the Mesolithic; enabling the exploitation of winter fowling on the Cromar lochs, and of marine resources on the coast. The Banchory area would be a suitable place mid-way between, that was sheltered in winter from both sea winds and the harsh upland weather, and particularly suitable for salmon fishing. This may explain why excavation at Nethermills revealed a relatively temporary structure, instead of the type of timber halls used by the Indians of the north-west coast of America. However, it is difficult to resist comparing Balbridie to these structures.

Nethermills

The Nethermills site is of considerable importance in understanding the Mesolithic occupation of this area, as the only modern Mesolithic excavation in the Banchory/Crathes area. It has been compared by Kenworthy to the site of Mount Sandel (Woodman 1977, 1978b p220-225), Northern Ireland, considered by Bonsall (pers. comm.) to be the only convincing example of a Mesolithic dwelling excavated in the British Isles. Both structures are more substantial than most of those found on other Mesolithic sites. Nethermills is about 4.5m in diameter compared to 6m for Mount Sandel. Both have post-holes of some size, and associated pits. Both are also multi-phase, there being several phases of the Mount Sandel structure, and the structure at Nethermills cuts earlier pits. With about 20,000 pieces of worked stone from Nethermills, including many scrapers as well as microliths and microburins, it seems reasonable to suggest that the site was a base camp. However, there is insufficient evidence to determine when, or for how long, the site was occupied. Kenworthy suggests that it would have been occupied in the winter, but this is based entirely on the probable location of food resources in winter, and the presence of hazelnuts, which could have been stored.

The proximity of Nethermills and Balbridie makes comparisons inevitable. They were located in the same environment, with the same available resources, excepting those introduced by farmers. Nethermills is assumed to be considerably earlier than Balbridie; Kenworthy (1981) compares the assemblage to one from Inverness dated about 4500 bc. Even if the site was radiocarbon dated and proved to be this date, there is no way of determining how much earlier, or later, other sites in the Banchory/Crathes area might be. Artefact typologies can only identify early or late Mesolithic assemblages, and then only if there are sufficient microliths. The details of the chronological relationships between Balbridie and the neighbouring flint scatters could only be determined by extensive excavation and absolute dating.

The fills of features at Nethermills were sieved for charcoal and other environmental evidence (Boyd unpub.). The charcoal indicated an oak dominated woodland with some hazel, birch and hawthorn, however, the pits and post holes also produced occasional charred seeds, including cereal grains and cereal weeds. Boyd argues that there has been little contamination of the Mesolithic layers by later charcoal, though cereal grains, being small, move much more easily through the soil than lumps of charcoal. Kenworthy (1981) states that worm activity was significant on the site, and expresses some concern about the reliability of the environmental evidence. The site has been disturbed by Medieval rig and furrows, and later farming, but the charred assemblage came from undisturbed features of Mesolithic date. Boyd claims that the assemblage of carbonised

seeds is similar to those found on Medieval sites. He considers later contamination to be more probable as an explanation for the presence of these seeds rather than Mesolithic agriculture or exchange with farming groups. An accelerator date on the seeds would be helpful, and until this has been produced the less "probable" possibility must remain open.

Balbridie

(Figure 6.21)

There is at present a lack of comparisons for this site, which limits interpretation of its function and place within the social landscape. However, the quantity of grain recovered suggests that at least one of its functions was as a store house (Fairweather and Ralston in prep.). Balbridie has some similarity to timber mortuary structures such as Balfarg, however, the former structure does appear to have been constructed to support a roof. Excavation at Lismore Fields, Buxton, Derbyshire revealed what initially seemed to be a similar structure, but it has now been reinterpreted as two small houses back-to-back. Even together they are only about half the size of Balbridie (Garton 1987). They have produced a very similar date to Balbridie, a weighted mean of the four dates is 4923 ± 35 BP; on both grain and wood charcoal. A possibly closer parallel was excavated in Ireland, at Tankardstown, Co. Limerick (Gowen and Tarbett 1988). Though roughly half the size of Balbridie the Tankardstown house has very similar proportions. Though it has no internal post-holes, possibly because of its smaller size, it has partitions at both ends, and the suggestion of convex gable ends. This structure has not yet been dated, but a smaller house (house 1) close by has five dates between 5105 ± 45 and 4840 ± 80 BP. Both houses produced plain, Western Neolithic-type pottery, and may be of a similar age.

The closest excavated parallel to the plan of Balbridie is Doon Hill A, Dunbar. Unfortunately this appears to be of a Dark Age date, even if the building tradition is of native, rather than Anglian, origin (Reynolds 1978). James *et al* (1984) list several "early Medieval" timber halls, including Balbridie. The paired posts interpreted at Yeavinger A4 as lintel and king post constructions for supporting the roof are paralleled at Balbridie. This structure is of similar size and proportions to Balbridie, but has only one internal partition, and has external posts helping to support the walls. Aerial photographs are rarely clear enough to identify typical Dark Age or Medieval plans from anomalous, possibly Neolithic ones, so excavation is necessary to recognise other Neolithic timber halls.

Though the scarcity of parallels for Balbridie is probably due to their confusion with later timber halls. Neolithic domestic structures have been found in many parts of Britain, and most are small huts, not dissimilar to those of the Mesolithic. Balbridie may have had a different function to most Neolithic structures, possibly at least a partial function as a grain store, or of a greater social significance. Alternatively, if Balbridie were purely domestic, it may have fulfilled a different need to the slighter structures elsewhere.

Possibly the similarity between small Neolithic and Mesolithic structures is due to both being temporary dwellings.

In terms of the distribution of sites in the valley, Balbridie is something of an anomaly. Contrary to Hunt (1987 p65) it does not parallel the location of the long barrows in the area. Three of the long cairns are north of the Dee, and some distance from the river. Finzean is south of the Dee, but on the north side of the Feugh, high on a south facing slope, so its situation basically is similar to the other barrows. All are at a considerable altitude, with good views, compared to Balbridie's low altitude position, the views from which would be very restricted if it was surrounded by forest. Though the scarcity of excavation of this type of monument in eastern Scotland means that the date and functions of these monuments is not known, and their chronological relationship to Balbridie can only be speculated on.

The pottery from under East Finnercy barrow is some distance north of the Dee, but that from Park Quarry is in a very similar position in relation to the Dee as Balbridie, close to the river on the fluvio-glacial deposits, on the south bank. The sherds come from a pit and are presumably contemporary with the filling of the pit. Axe and arrowhead distributions also indicate the concentration of Neolithic activity to the north of the river.

Balbridie seems to be in an atypical location compared to the other early Neolithic sites in the valley. Perhaps its early date suggests that settlement patterns did not change significantly until later. If the concentration on the north side of the valley was due to the demand for sun, and fertile soil for early agriculture, it might be expected that this shift would occur as soon as cereal production became significant. However, Balbridie is located on fertile land, and being in a broad part of the valley is not over shadowed by the hills. There would seem to be no reason why parts of the valley south of the river were not as suitable for agriculture as those north of the river. The quantity of grain at Balbridie certainly suggests successful arable agriculture by the time this site was in use. Its closeness to the Crathes concentration, and its location on the south side of the river could represent a typical Mesolithic settlement location. Perhaps, where the land was suitable for agriculture, there was no shift of settlement location at the start of the Neolithic, possibly indicating that the first farmers in the Dee valley were native hunter-gatherers.

6.2.2 Lithic assemblage analysis

The presence of microliths and microburins in the flint scatters in the Dee valley has caused the attribution of the scatters to the Mesolithic period. However, there was

clearly early Neolithic activity in the area, and there are probably several phases of activity on most flint scatter sites. Gardiner (1987) notes the "*rather narrow range of distinctive tool forms*" (p56) in the southern English early Neolithic, and it is probable that the Dee valley suffers similarly. Phillips (1989) also complains of the difficulty in separating late Mesolithic and early Neolithic assemblages using diagnostic artefacts. As elsewhere in Britain leaf-shaped arrowheads and polished stone axes must be relied on as indicators of Neolithic activity, but purely early activity is not easily recognised. The identification of Mesolithic assemblages largely relies on the presence of microliths and microburins, with little work having been done on the definition of Mesolithic assemblages beyond this (Woodman 1989). The use of diagnostic tools to characterise an assemblage ignores the bulk of that assemblage, which might provide supporting evidence in assessing its date.

This section probably attempts the impossible in searching for other criteria by which to compare the flint scatters. Ideally it is hoped to identify whether there are one or more types of industry present on a site. If the occupation of a site is restricted to one cultural phase, the assemblage should appear to be homogeneous, but occupation in various cultural phases will lead to a mixed assemblage. Various characteristics, identified as possible indicators of cultural and technological change, were recorded for each assemblage.

Surface collections are relatively numerous from the Dee valley, but of varying size and reliability. The existence and location of flint scatters now residing in museum collections has been mapped by Kenworthy (1975), and Shepherd (1987), but no detail of their nature and composition has been published. Excavated assemblages from the valley are generally small, but most have been published to some extent (Paterson and Lacaille 1936, Kenworthy 1981 and 1982). Kenworthy has been working on several of these collections for some time, in particular the Grieve collections, but the results are still in preparation.

This analysis concentrates on assemblages from the collections of Dr Grieve. The location of these sites are fairly accurately recorded, and most fields were walked several times under different conditions. Pieces as small as 1cm by 1cm were collected, suggesting that the sample of finds is as representative as is possible without sieving of the ploughsoil. There is no suggestion from his notes that the fields were walked in a particularly methodical way, and location of individual flints was not recorded. The spatial relationship of flints within a scatter can therefore not be studied. Generally, the Grieve collections

appear to be largely unbiased, and several are large enough to be considered broadly representative of the finds appearing on the surface at those sites.

Other assemblages are discussed where they contribute to the trends suggested by the larger Grieve assemblages. These assemblages are generally too small really to be considered representative of the total population of artefacts on their respective sites. The exception is Hilda Paterson's collection from around Birkwood, on the south bank of the river, near Banchory (M14). This collection is large, but problematic as it is an amalgamation of several discrete sites. There is no way to separate out finds from certain locations within the Banchory collection, with the exception of those few illustrated pieces from the small excavation at Birkwood (M12) (Paterson and Lacaille 1936).

Though small, the assemblages from Aberdeen are not surface collections, but mainly *in situ* deposits that have been professionally excavated (Kenworthy 1982, Stones pers. comm.). The recovery rate of flint on these excavations was presumably high, and the recovered assemblage must represent a large proportion of the worked flint present in the soil of the excavated areas. As surface collections represent a very small proportion of the material in the soil, the excavated assemblages must be much less biased than the surface collections. The other collections which will be mentioned where relevant include 224 pieces collected from Park (B5), and made available for study by Colin Lavery, some of the larger collections found during my field walking, and two collections made some time ago.

These last assemblages, the Charles Stephens collection (B2.1) from Mains of Kinmundy, near the Cloghill long barrow, and a collection from the Howe of Cromar (Z6), are much inferior in the information they can impart. They are small collections, but more importantly they are heavily biased. Half of the unbroken flakes in Stephens' collection have a length:breadth ratio of greater than 2:1, and very few flakes were broken. Both these collections also have a fairly large proportion of retouched pieces. The Cromar collection is also poorly provenanced. It is probably from round the collector's home at Ferney Howe, but this is not explicitly recorded. Unfortunately a large collection owned by Derek Milne, of Aberdeen, was unavailable for study as it is at present in storage, and in any case many pieces are mounted on boards, making a thorough study of them difficult. (See figure 6.6c for the location of the main assemblages discussed in this section.)

6.2.2.1 Method

The recording method is loosely based on the work of Ford (1987a) and Haley (1990), involving the measurement of various dimensions of unbroken flakes and cores, as

well as the identification of tool types. Most assemblages were small enough for the whole assemblage to be studied. Grieve C was too large to justify doing this, and Torrence (1978) has shown the analysis of a complete assemblage is often unnecessary, a probabilistically selected sample being sufficiently representative. Her experiments indicated that samples as small as 1% could give a reliable indication of the nature of the total assemblage. Samples greater than 25% showed no improvement in accuracy for the extra analysis time. A 50% sample of the Grieve C collection gave a large enough body of data to be statistically reliable, but significantly reduced the time and effort needed for analysis. A 50% sample of the Grieve A cores was also taken.

Where the assemblages were divided into bags, by criteria not directly related to the study, the correct percentage was taken from each bag, rather than a set number of pieces (Torrence 1978). The random sampling method used had the advantages of its suitability with small groups of finds, and the fact that it requires no equipment. The flints were tipped onto a table, well mixed together, and pushed into lines, in as arbitrary a manner as possible. This was effective with larger numbers, but with small numbers it was harder to be strictly arbitrary. Every second piece was selected. This is not a perfect method, but is better than grab sampling where small pieces tend to slip through the sampler's fingers. The number of pieces, rather than weight, was used to define the population and sample, mainly because of the inconvenience of carrying scales to the various locations where the collections were housed. However, it also makes small and large pieces equivalent, and prevents the over-representation of the latter.

All pieces were initially sorted into primary, secondary and tertiary flakes, and the number of burnt pieces was counted. Burnt pieces were not especially counted for Banchory and Grieve C, though distinctive burnt pieces were noted when measured. Unbroken pieces were then further recorded. Having laboriously recorded all unbroken pieces in the Banchory and Grieve C assemblages it was decided that only regular flakes would be fully recorded for the other large sites. It is assumed that the aim of knapping activity is to produce regular flakes, so these should be the best indicators of changes in preference in flake type. Concentration on these flakes was hoped to emphasise differences between assemblages, which might have been obscured by more arbitrarily knapped pieces. Regular flakes are defined as flakes with cutting edges and simple sections (Kenworthy pers. comm.), and I have placed no minimum size limitation on this category, as even the smallest pieces could have been used. All retouched pieces were recorded, even if they were fragmentary.

The detailed recording involved the measurement with callipers of the length and breadth. The work of Pitts (1978), Pitts and Jacobi (1979), and Ford (1987a), suggests that there is a reduction in the length:breadth ratios of unmodified flakes over time. Only Ford claimed to identify any difference between late Mesolithic and early Neolithic assemblages, so the probability of length:breadth ratios being a useful indicator is fairly low. However, this characteristic was studied to allow comparisons with other studies, and hopefully to assist in the identification of any late Neolithic or Bronze Age assemblages, which could then be excluded from further discussion.

The length was measured along the direction the flake was struck, and the breadth perpendicular to this (bulbar length and breadth). This is a common way of measuring flints, and has been argued to relate better to the method of flake production than maximum length and breadth (Haley 1990). However, the cutting edge of a flake was presumably its most important aspect, and maximum measurements reflect the length of the edge better than bulbar measurements. It also allows the representation of core maximisation, intended to produce the longest possible blades, whereas measuring bulbar length tends to under-emphasise this. In retrospect I would consider maximum measurements to be more useful in defining the dimensions of a flake.

The platform width was measured, and the platform type recorded using types 1 to 9 as defined by Tixier *et al* (1980), and 0 to represent a splintered platform (see appendix I, note 6.2). It was hoped that these factors may have some direct relation to knapping methods, and could reveal a change in technologies if one had occurred. Recording of platform type was only adopted after the completion of the analyses of the first two collections, Banchory and Grieve C, so there is no data on this feature for these sites.

Utilisation has been defined by the presence of "*minute chips*" along at least one edge of a piece (Palmer 1977 p39). This was initially recorded, but the majority of pieces had some chipping, and it was considered too time-consuming to inspect them all under a microscope to be sure that the damage was not post-depositional. Recording of this feature was therefore abandoned.

Some studies mention a change in flint colour at the end of the Mesolithic. On the Lancashire Pennines Mesolithic industries mainly use white and mottled grey flint while later industries use a broader range of colours (Leach 1951). At Glen Mor, Islay, Neolithic-type pieces were mainly honey coloured whereas the bulk of the assemblage, mostly of Mesolithic technology, was of grey flint (Mithen 1991). Hamilton (1983) has shown that in Grampian there is some selection in the Bronze Age towards grey flint, and

less use of brown flint in the production of arrowheads, compared to the Neolithic. She suggests that this may be due to a preference for metal-like colours, though if the aim was to simulate bronze, presumably browns would have been chosen.

In some cases the change in flint colour probably indicated a change in source and exchange routes (Leach 1951), but in eastern Scotland most sources are fairly mixed in colour. Certain locations on the Buchan gravels have flints of mainly one colour, e.g. Den of Boddam has predominantly grey, while Skelmuir Hill has mainly brown flint, though at other locations the range of colours is more varied. Beach pebbles occur in a whole range of colours. It seems probable that flint colours on a site may depend on which area was exploited, and whether there was a deliberate selection of certain colours. Some colours generally indicate better quality flint, but choice may also be related to other factors. It may be related to isochrestic variation (Sackett 1985, Wiessner 1985), an essentially random choice fixed by tradition, and has no real explanation, but is, nevertheless, a potential indicator of cultural change. Both social preference, and the location of flint sources could change as a result of cultural change, so colour is a possible cultural indicator.

Colour was recorded for all measured pieces. Patination clearly alters the surface colour, but the degree of patination seemed to be comparable on all sites, except for occasional anomalous pieces. The flints are therefore, probably rather browner than their fresh colour, but they are generally comparable to each other. Colour change can also be caused by burning. Identifiably burnt pieces have been excluded from discussions about colour, but heating can be difficult to detect, and this may account for some of the reddish colours. However, red flint is found naturally in the flint gravels. A Munsell chart was used to maintain comparability in the judgement of colours. Pieces were inspected in daylight, so the lighting was relatively standard, but, small variations in standardisation are unimportant, as the Munsell colours were grouped into general colour types (see appendix I, note 6.3). Differences between sites are best seen when the colours are amalgamated into three main colour types: brown/honey, light grey/pale, and other colours, including dark brown and dark grey, which are hard to distinguish from each other. These large generalisations should largely overcome any problems of differences in colour perception, either within the study, or between my classification and colour differences considered important in antiquity.

Retouched pieces were picked out during the initial sorting, and all recorded. Recognisable tool types are not included in the count of primary, secondary and tertiary flakes, or any other analyses involving the flakes. There was a considerable number with

slight, irregular retouch, especially notches. Though not studied in detail many of these were similar to types of plough damage described by Mallouf (1982). These miscellaneous retouched pieces are included in studies of both flakes and tools, because the simple and rapid nature of the analysis did not allow plough damage to be distinguished from deliberate retouch. For the Banchory and Grieve C collections miscellaneous retouched pieces were only recorded if they were unbroken.

Accepted chronologies for tool types are not questioned, so no attempt has been made to study tool typologies in any depth. Microliths have been classified using Clark (1933) (see appendix I, note 6.4), and scrapers have been classified by the location of the scraper edge on the blank. This is somewhat subjective, e.g. the difference between end and side/end scrapers is often not clear, nor is the shortest side easily determined on nearly circular pieces. However, it is adequate as a simple classification (see appendix I, note 6.5). Other tool types were not numerous enough to make division into categories worthwhile.

Cores are useful in identifying technologies. Good blade cores are easily recognised, with their neat pyramidal shape, and most removals are long and thin. Less regular cores are less easy to categorise, and may be atypical blade cores or flake cores. Judging cores purely by the nature of the removals visible on them is not entirely reliable. Cores found in the archaeological record are generally discarded specimens, so they are normally either failed or worked out, as was demonstrated by the number of hinge fractures on many cores. In both cases, surviving scars may not be typical of removals made during the use of the core. The number and type of removal scars was classified using a system borrowed from Ford (1987a), see appendix I, note 6.6 for classifications. Classes 1 to 4 are considered to be blade cores, 5 is intermediate, and 6 and 7 are flake cores. The platform type of the cores was recorded using classes described in appendix I, note 6.7. Other characteristics were considered, but only colour was thought to be particularly useful for this study. Colour was recorded in the same way as for the flakes.

6.2.2.2 Results

Flakes

All the main sites had some primary flakes (figure 6.22). The Stephens collection has been included in the graph, despite its small size, to demonstrate the biased nature of this collection. It consists almost entirely of tertiary pieces, mostly fine blades, and is clearly the product of highly selective collecting. The differences among the other sites are

more significant. The high proportion of primary flakes on Grieve C, in comparison with Grieve A, may imply more knapping occurred on this site. However, both sites have a large number of cores; possibly more initial core preparation occurred at Grieve C, with more ready-prepared cores being used at Grieve A. Grieve B and G have a large proportion of tertiary flakes, also suggesting ready-prepared cores were introduced to these sites. Unfortunately the small size of both assemblages means that this trend may not be representative of the actual proportion of flakes that were on the sites.

Most sites have some burnt pieces, and in some cases, e.g. Grieve B, these can reach a considerable proportion of the total assemblage. While it may be possible for stubble burning fires, occasionally, to reach a temperature sufficient to cause changes in flint, this is probably a very rare event. Temperatures of 350-400°C have been found necessary to cause changes in flint (Purdy 1975), and these would be unlikely to be reached for long enough in stubble fires. These pieces may have been burnt accidentally in domestic fires during the occupation of the sites. The burnt pieces in the ploughsoil at Grieve C tended to be concentrated near burning associated with the Nethermills hut, as revealed by excavation (Kenworthy pers. comm.). While quantities of burnt flint cannot be taken as proof that there were hearths on all the sites, it seems the most likely explanation for significant proportions of burnt flint. The high proportion of retouched pieces from Grieve C emphasises its function as a base camp, revealed through excavation. The fewer retouched pieces from other sites may suggest they were reoccupied less frequently, or used by fewer people.

Analysis of length:breadth ratios did not prove illuminating. Graphs of tertiary flakes alone presented the clearest indication of trends in flake dimensions. However, all sites produced very similar graphs (figures 6.23a-f). Banchory and Grieve J have fewer large pieces compared to other sites (figures 6.23e and f), as Grieve noticed when he was walking site J. He attributed this to the higher clay content of the soil. The greater resistance of the soil could have resulted in more pieces being broken during ploughing. Flakes from the Aberdeen sites produce similar graphs, and are also distributed fairly evenly round a 2:1 ratio (Kenworthy 1982).

If blades are defined as having a length:breadth ratio of greater than 2:1, the percentage of blades in each assemblage can be calculated. Blades are presented as a percentage of the unbroken, regular flakes because of the way in which the assemblages were recorded, unfortunately this makes comparison difficult with the lamellar index of sites, such as Kinloch, Rhum (Wickham-Jones 1990).

Site	Blades (%)	Flakes (%)
Grieve A	71	29
Grieve B	56	44
Grieve C	36	64
Grieve H	50	50
Grieve J	72	28
Banchory	35	65
Park	38	62
Upper Ruthven	20	80
Nether Kirkgate	15	85

Grieve A, B and J actually have more blades than flakes. The latter two sites have a relatively small number of pieces, so the percentages may be a little distorted. Grieve A has many more pieces, and is clearly orientated towards blade production. In association with the large proportion of microburins from this site, this indicates that microliths were produced here. Grieve H has so few regular pieces that the proportions of blades and flakes have little meaning. Grieve C, Banchory and Park have very similar proportions of blades and flakes, with flakes being the more numerous. Upper Ruthven (B10) and Nether Kirkgate (M2) present a rather different pattern. Upper Ruthven is some distance from the Dee, and might be expected to have a different nature to the assemblages from the Deeside sites, whether because it is of a different period or associated with different activities. Nether Kirkgate had some Mesolithic activity as is demonstrated by the presence of microburins on the site, but the proportion of blades is very low. This might suggest that blades are not always a reliable indicator of period, especially if material from several periods is mixed.

If an emphasis on blade production is assumed to suggest late Mesolithic industries, as argued by Ford (1987a), many of these assemblages would appear to be of that date. Ford's criterion for identifying late Mesolithic assemblages is that over 33% of the intact pieces are blades. This is based on only four Mesolithic sites from southern England, and may not be relevant to the Dee valley. Other studies of length:breadth ratios and chronology are also confined to southern English material, and can only be cautiously compared to the present results. Pitts and Jacobi (1979) actually noted a tendency in Neolithic assemblages for debitage to include narrower flakes than those in Mesolithic assemblages. Using length:breadth ratios Pitts (1978) identified a clear separation between early and late Mesolithic, in the material he studied from southern England. However, the poor quality of flint available in the Dee valley may restrict the success of fine blade production, reducing the difference between the narrow blades of the early Mesolithic, and the later, broader blades. Pitts also found a fairly clear difference between

early and late Neolithic, with the latter being characterised by broader flakes, but no division between late Mesolithic and early Neolithic. Pitts used multivariate statistics, and secure groupings of sites may not be possible without this. From the Dee valley assemblages it is possible to say only that they were aimed at the production of blades, and a date of late Mesolithic or early Neolithic, rather than Bronze Age, seems reasonable on the evidence from length:breadth ratios.

There was minimal evidence for special platform preparation from the flakes, most platforms being plain, but there are some intersite differences in the platform widths (figure 6.24). Narrower flake platforms may be due to the use of hammers of medium hardness (Wickham-Jones 1981), but the relationship between hammer hardness and the flake produced can be variable (Wickham-Jones 1990). The sites fall into two groups: those with a higher proportion of narrow platforms, and those with a lower proportion. All sites have a large number of very narrow platforms, Grieve A, B and H have around 30% 0.1cm platforms, whereas the rest of the sites have just over 20% or fewer. These three sites also have more 0.2cm platforms, and Grieve A and B have fewer 0.3cm platforms than the rest. Grieve H and J have no particularly wide platforms, though the rest have small proportions of these.

Cores

Core types also indicated an emphasis on blade production. The large proportion are blade cores, though there is a substantial number of flake cores (figure 6.25). Ford's findings (1987a) might be used as a rough comparison, though his interpretations cannot be applied to this material. He defines Mesolithic assemblages as having over 63% blade cores, slightly more than on the Grieve sites. The lower figure on Deeside could be due to the poorer quality flint used here, or the more exhaustive use of cores because flint was less available than in the area Ford was studying. Even if the technology is devoted to the production of blades, some flake cores are to be expected. These will mainly be failed cores, or those that have been entirely worked out, and only a few small scars remain. However, Grieve H has significantly more flake cores than blade cores, and by Ford's system would be classified as early Neolithic. The number of flakes from this site is too few to be certain whether flake production was important. The predominance of flake cores could be due to particularly poor material, and therefore more failed cores, but hinge fractures are generally less frequent, and less severe than on other sites, especially Grieve A. The material used is also similar to that on other sites, and there is no suggestion that it is of poorer quality.

Perhaps an indication of flake cores being associated with Neolithic technologies might be drawn from two of the field walked sites near Westhill. Unlike the other sites discussed, Borrowstone and West Hatton produced only flake cores, though the numbers are very small, and may not be representative. Borrowstone produced two invasively retouched pieces, one a leaf-shaped arrowhead, and at West Hatton a bifacially, invasively retouched piece, that may be the broken butt of a leaf-shaped arrowhead, was found. The absence of blade cores from these sites might indicate no early activity occurred there, as at the riverside sites, though further field walking could suggest otherwise.

Most of the sites have many single platform cores, worked part way round (figure 6.26). These are often pyramidal in shape, and are a classic form of blade core. Grieve H has just over 20% of this core type, and much greater proportions of other cores, especially those with two oblique platforms, and three or more platforms. The latter are typical of flake cores, though blade cores can have more than two platforms. Grieve J has a relatively high proportion of two platformed cores, but these are quite typical of blade cores. There are comparatively few cores from this site, so the proportions may be distorted, and not entirely representative of the total population. Grieve C has over 20% of cores with more than two platforms; as there were many cores from this site, this must be considered fairly representative. It may suggest later activity on the site. There are very occasional splintered pieces on some sites, often of a very small size. These are typical of assemblages with poor or small material, and are common on the Mesolithic sites on the west coast of Scotland (Mercer and Searight 1986, Mellars 1987). Clearly this technique of bipolar flaking was rarely necessary on Deeside, except with particularly small pebbles. It is possible that these splintered pieces were also used as tools, and some authors, e.g. Mercer (1971), refer to them as wedges or chisels.

Colours

Two groups of sites are defined by flint colours. Banchory, and Grieve B and H have cores that are predominantly light grey and pale, and relatively few brown and honey coloured cores (figure 6.27). Grieve A, C, and J, have much closer proportions of the two. Grieve A is notable for having a greater proportion of honey than grey cores. The colour of unretouched pieces emphasises the difference (figure 6.28). Grieve A has mainly brown and honey coloured flakes, while Grieve B, Grieve H, Banchory, and Park have predominantly light grey and pale ones. Grieve C and J are not as clear cut, having roughly equal proportions of honey and grey coloured flakes. The Banchory collection has a majority of grey flakes, but it represents several different sites, including Grieve J, which seems to have more honey coloured flint than the average.

The material used on the Queen Street/Broad Street site in Aberdeen is, not surprisingly, beach pebble flint, honey flint being most common. Honey and brown flint are even more important on the Green site (Kenworthy 1982). Nether Kirkgate has a much more even mix of colours, with light grey being most frequent. The colours of the smaller assemblages have not been recorded. Unworked beach pebbles were collected from the beach at Forvie Sands, about 20km north of Aberdeen, to give some indication of the natural proportions of flint colours. Out of 15 flint pebbles 6 were honey or brown and 9 were grey, though rather darker than the grey flint common on the archaeological sites. Clearly a proper survey of the flint along this coast is necessary to establish the natural range of flint colours. However, it might be suggested that the flint is naturally varied in colour, and the predomination of honey coloured flint on some of the coastal sites suggests that some selection for colour occurred even close to the flint source.

Even more significant is which colours were actually used to make formal tools (figure 6.29). At Grieve A, no tools were made of light grey or pale flint, showing that, despite the presence of this flint on site, there was a clear preference towards brown and honey coloured flint for tools. A similar, but less clearly defined preference is seen on Grieve C. At Grieve B, tools were almost always made of light grey flint, despite the importance of pale flint in the flakes. At Grieve H, pale flint was used. There is no clear preference in the Banchory collection, which is not surprising considering its mixed nature.

There is a clear preference for brown and honey flint for leaf-shaped arrowheads. Out of 38 arrowheads whose colour is known, the following colours occur. The information is taken from Hamilton's catalogue and my own study of the Banchory collection.

Colour	No. of arrowheads	% of Total
brown/honey	29	76
light grey	6	16
other	3	8
Total	38	100

This suggests some continuity of colour preference between the presumably Mesolithic activity, represented by microliths and blade cores, and traditionally Neolithic artefacts, though it provides no support for flake core dominated assemblage at Grieve H being Neolithic in date. Kenworthy (1981) has associated light grey flint with early

Mesolithic activity, but does not give an explanation for this. The light grey/pale flint assemblage at Grieve H has no features suggesting it is of this age, but might be related to the increased use of grey flint for early Bronze Age arrowheads.

If one colour of flint was better for tool-making than the others, presumably it would be preferred on all sites, considering the similarity of the assemblages. Colours could be related to the source of the flint, though that would not explain the preferential use of certain colours for retouched tools. Small flint pebbles with water-worn exteriors are found on most sites, suggesting importation of material from the coast, though battered exteriors more typical of the Buchan gravels are also seen. These two sources are not easily distinguished, but there is no indication that the predominant colour of an assemblage is related in a simple way to the source of flint.

If cultural factors influenced selection of flint, the occupants of all the sites could have used the same flint source, but concentrated on the collection of particular colours. The lack of temporal information makes it impossible to determine if this preference changed over time, or was part of the stylistic difference between contemporary groups. Further work would be necessary to clarify the role of colour as a cultural indicator in lithic assemblages in the valley.

Tools

Tool types should provide the most unequivocal information on the sites studied. All the larger sites studied had a small proportion of retouched pieces, including both microliths and scrapers (figure 6.30). Banchory is unique in having more microliths than scrapers, suggesting a different function to the other sites; possibly a greater emphasis on hunting. However, the amalgamation of finds from different sites makes any conclusions about Banchory unclear. There is no way of identifying whether the scrapers came from one site, or were widely dispersed. With 117 microliths, Banchory has a huge number compared to the other sites. Paterson was particularly interested in Mesolithic diagnostic artefacts (Paterson and Lacaille 1936), but the large number of small, waste flakes that she collected suggests that she was not selective about what she collected or kept.

This collection also has a significant proportion of microburins, possibly indicating sites specifically used for microlith production. Grieve A also has a considerable number of microburins, almost as many as microliths. This may be due to soil or fieldwalking conditions being particularly suitable for finding small pieces, but Grieve specifically mentions that despite visiting the site on numerous occasions, conditions were never good. With over 45% scrapers, other activities must have been occurring at this site,

but there seems to have been a concentration on making hunting equipment. Grieve B has a fairly significant proportion of microliths, largely because there are relatively few tools from the site. Grieve C has 17 microliths, though these form a small proportion of the tools, because of the very large number of scrapers (101). Grieve C is the largest discrete site, so more tools would be expected; however, the large number of scrapers supports the view that it functioned as a base camp. Other sites with high proportions of scrapers, Grieve B and H, have relatively few tools, and the percentages are probably distorted by the small sample size. Though Grieve C and H have similar proportions of microliths, the actual number on C is 17, and on H is only 2, indicating the problems of small samples.

Most sites have a small number of burins and perforators. Both these classes are a little insecure, as confusion with plough damage and other retouch types is potentially significant. A burin spall can easily be removed accidentally, and I never succeeded in feeling confident that I could identify genuine burins. Perforators may also be confused with plough damaged pieces, especially if the damage is on a piece that has some genuine retouch on it. The low numbers of these types makes the poor identification of little importance.

While the sites north of the river clearly fall within the class of base camps by their predominance of scrapers as well as occasional other tools, the Banchory sites have remarkably few scrapers, and seem to have been almost entirely hunting sites. However, it must be noted that there is some evidence that microliths were used for functions other than as projectiles (Finlayson 1990). Grieve J produced few tools, despite the considerable quantity of waste, and is of no help in illuminating this problem.

The presence of post-Mesolithic artefacts on some of these sites indicates later activity on, or near, the Mesolithic sites. Gardiner (1987) lists fabricators under tools of both the Mesolithic and Neolithic, though Piggott (1970 p286) considers them to be characteristic of the Bronze Age. It is possible those at Grieve A and C represent later knapping (figure 6.31).

Diagnostic artefacts

Those sites with a significant number of microliths were compared, as microliths are the most distinctive artefacts for dating Mesolithic assemblages (figure 6.32). Truncated pieces, microblades with microlithic retouch obliquely truncating the distal end, and often with the butt intact, were included with the microliths, as they are very similar artefacts and equally diagnostic of the late Mesolithic. All the sites studied contained mainly classic geometric microliths and rods, considered typical of the late Mesolithic. All

the sites also have truncated pieces, equally typical of the late Mesolithic. Grieve A had one piece that appeared to be an obliquely blunted, non-geometric form; these are normally considered to be early Mesolithic, but probably continued in use into the late Mesolithic. It is possible that the large number of rod-microliths in the Banchory collection may be of chronological significance. Similar rod-dominated sites on the Pennines have been dated to the end of the Mesolithic, but the dates are far from secure, and chronological sequences within the late Mesolithic are very difficult to determine.

Kenworthy (1981) considered Nethermills II to be an early Mesolithic site, presumably on the presence of non-geometric microliths, though details are not given. He has also indicated that Grieve B is an early site (pers. comm.), but the microliths inspected did not support this. The microliths suggest a firmly late Mesolithic date for at least some of the activity on these sites, and evidence for early Mesolithic activity is very slim. Where microlith numbers are low, e.g. Grieve H, Mesolithic activity may only have made a small contribution to the flint scatter.

Mulholland (1970 p87) mentions the difficulty in distinguishing between Mesolithic and Neolithic scrapers, but some variation can be seen between the assemblages as a whole. There is a clear predominance of end scrapers on most sites, with the exception of Grieve C, which has almost as many side scrapers (figure 6.33). Grieve H is notable for having a very limited range of types, with only end scrapers being represented in significant numbers. Young (1987) found that scrapers in the Wear valley became longer and broader over time, and the only difference Mulholland could detect was that Mesolithic scrapers tended to be smaller and thicker than Neolithic ones. It seems possible that the rather large, slightly more elongated forms on Grieve H may be the product of a later occupation than those occurring on the other sites. Ettrick Croft has a large proportion of scrapers, probably because these are fairly large, and were most easily seen by the farmer during ploughing. While it is dangerous to draw conclusions from such a small collection, the range of types and their proportions can be seen to be roughly similar to most of the larger sites.

A small number of scrapers from Banchory and Grieve C had shallow, invasive retouch on the body of the blank. Richards (1990) found scrapers of this sort to be consistently associated with Beaker activity in Wiltshire. Though typologies from southern England may not related very closely to the Dee valley material, it seems likely that these are later forms, and are probably related to the same activity that produced the leaf-shaped and barb-and-tanged arrowheads. These later scrapers indicate that there were activities other than hunting carried out in this area in post-Mesolithic periods.

Unfortunately, there is no way to identify where these scrapers came from, and whether a substantial later site existed this area, or whether these were scattered finds from several temporary sites.

It is useful to compare the finds from Grieve C with those from the Nethermills excavation, located at one of the find concentrations within this flint scatter (Kenworthy 1981). Unlike the surface collection, more blades than flakes came from the excavation. The proportion of cores from the excavation was very low, suggesting that these were often brought up to the soil surface, and were over-represented in the surface collection. Microliths were more frequent from the excavation, as sieving of soil recovers far more small pieces than can be recovered by fieldwalking. There were even more microburins than microliths, suggesting that Grieve A is not unusual in the on-site production of microliths. There must, in fact, have been some difference in soil or collecting conditions that favoured the discovery of small pieces on Grieve A. Scrapers were also considerably less numerous from the excavation than from the surface collection. This demonstrates a strong bias in the surface collections for large, easily recognisable pieces, and against small pieces.

The analysis of these assemblages therefore supports, in general, the claim that they are Mesolithic in date. There may be some early Mesolithic activity on the sites, but the bulk of the material is probably late Mesolithic. There is also some later activity in the area, which seems to have been more significant than just the loss of arrows during hunting trips. Invasively flaked scrapers at Banchory and fabricators at Crathes suggest at least slight Neolithic or later occupation. Grieve C even has barb and tanged arrowheads, suggesting activity at least in the area in the early Bronze Age. This may also explain some of the multi-platformed flake cores, which appear in small numbers. This later activity suggests the reuse of exactly the same sites as used in the late Mesolithic, as the debitage on the Grieve sites is generally located within a discrete scatter, even where later occupation is probable. Unfortunately it is impossible to know how much, and what type of debitage is associated with each phase of occupation.

Grieve H does appear to differ from the other assemblages. There is no significant difference to be seen in the flakes, though this could be due to the small size of the sample. Core types, and core platform types, from this site single it out. The use of mainly pale flint for retouched pieces is also unique to this site, though again this is based on a very small sample. The proportion of scraper types from the site are also different from the other assemblages. The location of the site is very similar to the rest studied, so it seems unlikely that the differences are due to different tasks being carried out there. The

differences are also those which are commonly used to define Neolithic from Mesolithic assemblages: more flake cores, of less regular shapes; a change in raw material source, or at least preferred colour, and a change in tool form. None of these differences are very distinctive, but problems of the identification of early Neolithic assemblages elsewhere suggest that the difference between late Mesolithic and early Neolithic flint assemblages would be small. The lithic collection from the Balbridie excavation was briefly inspected, and the initial impression was that there were fewer blades than in most of the other assemblages, but time limitations prevented its inclusion in this thesis.

It might be concluded from this brief analysis that most of the large collections from along the Dee seem to be mainly the products of late Mesolithic occupation with a small amount of earlier and later activity. The assemblage from Grieve H is different enough from the others to suggest that it is due mainly to later occupation, probably Neolithic. This site and the evidence for later activity on other sites suggests suggest some Neolithic activity along the river, possibly using some of the sites traditionally used by the Mesolithic groups. It would be wrong therefore, to assume that all riverside flint scatters are Mesolithic, without further investigation.

6.3 Conclusion

There is a strong suggestion from the existing evidence that late Mesolithic activity was concentrated along the river, possibly with a particular concentration near Banchory and Crathes. The brief tests of both the distribution pattern and nature of the riverside sites provided no evidence to the contrary. Clearly this small study has only touched on these problems, and further work could dramatically change the perceived pattern. The fieldwalking demonstrated the ease with which new sites could be found in the valley, and how easily the general trends could be changed, even in an area that has had a long history of artefact collection. More work could reveal new patterns, which would still be limited by the difficulty of locating finds on the uplands and permanent pasture of the upper valley.

Though late Mesolithic activity does seem to have been restricted to the river and later activity to be more widely dispersed, there are clear indications that the river banks were not abandoned in the Neolithic, and early Neolithic settlements in particular may have been concentrated in the same locations as the Mesolithic ones. Grieve H, the Park Quarry pit and Balbridie are all situated in the same type of location as sites with predominantly late Mesolithic assemblages. However, recognition of purely early Neolithic sites is problematic because of the poor understanding of the chronology of the artefacts and monuments found in the valley. Without excavation the long cairns cannot necessarily be assumed to be early Neolithic. The Western Neolithic pottery from under the East Finncery barrow and at Park Quarry gives some indication of early Neolithic activity, but pottery only survives in extraordinary conditions in the acid soils of the valley. The evidence from southern English studies that blades and blade cores were used in the early Neolithic suggests that the Dee valley assemblages that are dominated by flake cores may be late Neolithic or early Bronze Age. The leaf-shaped arrowheads and stone axes may also be of this date. Only the dated structure at Balbridie can be confidently assumed to represent the early Neolithic in the Dee valley.

One of the main functions of this chapter was to study the patterns recognised in the previous chapter in greater detail. The effect of doing so is largely to emphasise the problems of site distribution patterns. The difficulties of the poor chronology of features and artefacts used to identify the early Neolithic become even more clearly defined on a small scale. In the Dee valley it is impossible to identify the full distribution pattern of the first Neolithic settlements, because it is impossible to recognise which axes and arrowheads are from later in the Neolithic. Factors influencing site location do appear to change in the Neolithic, as sites are no longer restricted to riverside locations. The

distribution of polished stone axes gives some indication that the most fertile land was favoured, but there is little to indicate at what point this change occurred. However, there is a small amount of evidence that suggests the river as at least one focus for the earliest Neolithic activity in the valley. This implies considerable spatial continuity between late Mesolithic and early Neolithic, with possibly a more extensive use of the landscape only later in the Neolithic.

While there is no evidence for the contemporaneity of Mesolithic and Neolithic cultures it seems unlikely that the valley would be abandoned during the fourth millennium bc, leaving an empty valley to be reoccupied by farmers. Presumably therefore the early Neolithic occupation was situated in the heart of the hunter-gatherers' territory. Was Balbridie an intrusion of alien culture torched by a hunter-gatherer raiding party, or was it a logical development for a semi-sedentary salmon fishing community? The close proximity of late Mesolithic and early Neolithic sites along the Dee suggests that some answers might be found in future, though it would require a large scale project.

The conclusion of this chapter unfortunately must be that not only is a great deal of work still needed before early site distributions can be discussed with any degree of confidence, but that the early Neolithic in particular would seem to be largely invisible in the Dee valley. If a search for these sites were carried out it would seem most promising to start with the "Mesolithic" flint scatters within a few kilometres of Balbridie. If there is no discernible change in the lithic assemblage, and no diagnostic artefacts at the start of the Neolithic, only excavation and a detailed dating programme can hope to identify these sites. It is unfortunate that the Nethermills site has not yet been dated, as it would have provided an interesting contrast to Balbridie.

CHAPTER 7: THE BEGINNINGS OF AGRICULTURE AND NEOLITHIC CULTURE IN GREAT BRITAIN.

Herne (1988) considers that the sparse and patchy evidence for both the late Mesolithic and early Neolithic in Britain means that there is "*no visible Mesolithic/Neolithic transition, only a relatively rapid transformation in the means and forms of cultural expression. There is no archaeological evidence for economic transition*" (p25). Though this statement may seem extreme this thesis can only come to a similar conclusion. There are good arguments for both acculturation and colonisation hypotheses, but the real problem is how to judge these rival models when the available data is poor in quality and quantity. If the Transition was in fact rapid the chance of finding an intermediate site would be small (Ashbee 1982, Waterbolk 1971b), making the study of the Transition itself virtually impossible. But the data seems inadequate to demonstrate whether the Transition was rapid or not.

Early British agriculture seems to have been relatively advanced, including the use of the rip ard, and extensive cattle herding, possibly for milk production as well as meat. Pottery was well developed, and early tombs were often large and impressive. As far as can be determined from the site distribution evidence early Neolithic settlements were concentrated in fertile valleys and along the coast. This mature culture could be the product of a preceding pioneering or experimental phase, but the evidence for this is ambiguous. The existence of a pioneering Neolithic is based on supposition, not evidence, but Neolithic culture is defined by its mature aspects, and it is questionable whether sites lacking this mature culture could be distinguished from Mesolithic sites.

The considerable problems of producing evidence on the Transition has encouraged the use of spurious data in the support of pet theories. Darvill (1987) claims that pioneering farming groups are evident in the archaeology for "*perhaps three centuries*" before the establishment of the full Neolithic complex (p50), though his argument is based on dates from Peacock's Farm (Clark and Godwin 1962) and Broome Heath (Wainwright 1972). The latter date is on buried soil, and may not be closely related to the artefacts within the soil. The former dates were on peat, which was not closely related to the archaeology, and they were rejected by the excavators as dates for the Neolithic activity on the site. Darvill also supports his argument with evidence of early woodland clearance that could as easily be attributed to Mesolithic activity as Neolithic. Healy (1984) also uses spurious dates to support a particularly early Neolithic presence,

but selects dates from sites with a fully Neolithic culture²⁹. This presumably allows the date of pioneer settlements to be pushed even earlier, but because the data is false, the theory lacks weight.

Excepting Ballynagilly, no settlement with any material traits characteristic of the Neolithic has been dated before the main expansion of Neolithic material culture in Britain. The catalogue in appendix II provides no clear evidence of monuments in general being dated later than the dated settlement sites. Proposals for pioneer settlements must, at the present, depend on palynological evidence. If the elm decline is accepted as an indicator of farming activity its occurrence, slightly earlier than archaeological dates in some areas, might suggest earlier agricultural activity. However, the discrepancy could be due purely to the errors of dates on peat. Even if this event is discounted as evidence, there are a considerable number of early examples of cereal-type pollen grains. In most cases these are dated in reference to the elm decline, which, as far as archaeological time scales are concerned, is not as perfect a dating horizon as was thought. Many pre-elm decline cereal-type pollen grains could be no earlier than dates on Neolithic sites in the same area. The few grains from radiocarbon dated pollen strata do suggest agricultural activity in the early fourth millennium bc, but these could equally be attributable to wild grasses (especially on the coast), contamination, or dating errors. The cultivation of small areas of cereals is probably unnoticeable by palynology, and it is probable that only more extensive and mature agricultural activity is likely to be represented in pollen diagrams (Larsson 1985, Rowley-Conwy 1981). In this case only fairly large scale, mature arable agriculture would normally be recorded in the pollen data, and it would seem impossible to use palynology to demonstrate whether there were early experiments in farming in Britain or whether it arrived in a fairly advanced form. The relationship between dates for early cereal-type pollen and those from Ballynagilly may be coincidence, but it does present some hope that further research might reveal more particularly early Neolithic-type activity. However, this can only be demonstrated in the future, and it is premature to argue for the presence of pioneer settlements from the existing evidence.

The dating evidence is inadequate to demonstrate with any degree of confidence when the Mesolithic ended. Several authors (Lacaille 1954; Radley 1969; Mulholland 1970) have discussed the possibility of groups with a traditional Mesolithic culture and economy surviving into the third millennium bc. Sand dunes in Scotland continued to be occupied over millennia, probably by groups carrying out Mesolithic-type activities, i.e. seasonal

29. i.e. Balbridie (Ralston 1982), Briar Hill (Bamford 1985), Carrowmore (Burenhult 1984), and Lambourn long barrow (Wymer 1970). See chapter 3 and appendix II for discussion of problems with these sites.

hunting and gathering, but these finds are typical of later material cultures, and only the activities being carried out reflect continuity (Lacaille 1954). A similar situation appears to exist on the uplands of North Yorkshire (Spratt and Simmons 1976) and the Fens of Cambridgeshire (Tilley 1979).

Support for the actual survival of a recognisably Mesolithic culture is more elusive. The presence of Neolithic arrowheads and axes on lowland Mesolithic sites has been suggested to represent the use of these items by people living an otherwise typically Mesolithic life (Spratt 1982). Mesolithic artefacts are often found in surface scatters with Neolithic and Bronze Age material, but without stratigraphic evidence it is impossible to identify residual material. In North Devon, Mesolithic artefacts occasionally have the same patina as later flints (Grinsell 1970), but this is a poor temporal indicator, and cannot be used to prove contemporaneity. Pottery apparently associated with Mesolithic industries on sand dune sites, such as Luce Sands, is equally unreliable, as stratigraphy is very poor in a dynamic dune system, and artefacts of different periods can often end up at the same level (Lacaille 1954). Mulholland (1970) does mention an artefact that appears to be a microlithic copy of a barb and tanged arrowhead, found at Dirleton, East Lothian, but whether this is a genuine copy made by people of a Mesolithic tradition, or just an anomalous form seems impossible to determine. Saville (1981) also mentions a fragment of a polished flint implement from Over Witchery, Warwickshire, that had been reworked with microlithic retouch. Though the form is not strictly a microlith Saville suggests this may be an example of Mesolithic reuse of a Neolithic implement, implying the contemporaneity of the two lithic traditions.

Whittle's claim (1977) that the cultures of the late Mesolithic and early Neolithic in Britain are too dissimilar to justify acculturation is worth some consideration. The problems of identifying flint industries from the two periods ^{ve} has been mentioned in chapter 5. Studies of debitage have been unable to demonstrate any significant change, and there are various reports of early Neolithic flint assemblages with a very Mesolithic character. Richards (1990) reported an assemblage with a high proportion of blades and bladelets from the Coneybury Anomaly, Wiltshire, associated with pottery, domestic cattle bones and a late fourth/early third millennium radiocarbon date. At Gwithian, Cornwall, Neolithic pottery appears in later layers, but the flint industry remains indistinguishable from the local Mesolithic industry (Mercer 1986). The early third millennium bc house at Fengate, Cambridgeshire (Pryor 1976) and the Neolithic enclosure at High Peak, Devon (Pollard 1966), both produced lithic assemblages with fairly high proportions of blades. The only significant difference between Mesolithic and Neolithic lithic assemblages at Newton, Islay, was the presence or absence of microliths (McCullagh 1991). While

microliths and microburins seem to be characteristic of the Mesolithic, there is no evidence that blade industries are purely Mesolithic, and these could be associated with early Neolithic activity. A change in the basic flint industry does not appear to be demonstrated at the start of the Neolithic. Bradley (1987) has suggested that blade cores possibly represent the lightweight, adaptable tool kits of mobile groups, indicating the existence of some mobile groups in the early Neolithic.

The two periods also have many tool types in common, particularly manufacturing and processing tools (Pitts and Jacobi 1979). But, domestic tools might be expected to remain unchanged if their functions were the same; meat, hide and plant processing must have occurred in both periods (Kinnes 1988). There are some indications that artefacts useful in agriculture already existed in the Mesolithic. Antler mattocks have wear marks consistent with use for digging. In the Neolithic they were used for quarrying, but the Mesolithic ones are different in construction, and may have functioned as digging sticks, i.e. Mesolithic people already possessed a tool that could be adopted for agricultural use (Smith 1989).

Though site distribution patterns for both periods are similar, especially for residential sites, the reasons for this are not clear. Excepting the Neolithic monumental sites, both periods are represented mainly by flint scatters, and the same survival and discovery factors might be expected to have a strong influence over the distribution of known sites. Certain aspects of the physical environment would be important in determining site location in both periods; availability of water, routeways, food and other resources must have had continuing importance. It is hard to determine whether the similarity in distribution is due to continuity of settlement, or independent factors. Neolithic sites might have been concentrated in coastal and riverine locations because these had the best land (Donahue 1992), or because this is where Mesolithic populations had been concentrated. Pioneer agriculturalists would be likely to occupy areas with alternative resources, because of the high risk of crop failure, so they would be likely to be found in similar locations as Mesolithic groups (Bradley 1978). Certainly there is minimal evidence for avoidance of one culture by the other, yet if two separate populations had occupied the same areas more evidence of contact or conflict might be expected.

Economically the change from Mesolithic to Neolithic was probably quite significant, though the use of wild foods continued into the Neolithic. Ethnological evidence suggests that *"the role of hunting and the collecting of wild vegetable foods in societies normally regarded as cultivators has been substantially underestimated"* (Ellen 1977 p37), and wild species continued to be exploited throughout

the Neolithic. There is considerable evidence for the use of wild plants, especially hazelnuts, all over Neolithic Britain, though it is hard to determine their economic importance (Moffett et al 1989). Shellfish exploitation and deer hunting continues in the Neolithic (Young 1987), including the continued use of shell middens whose formation began in the Mesolithic (MacKie 1972), and use of the same areas for hunting (Spratt 1982, Spratt and Simmons 1976). Fish was of economic importance at Skara Brae, Orkney (Clarke 1976b), and a significant proportion of the faunal assemblage from the Coneybury Anomaly was wild species. This site is claimed as a genuine transitional site, with both mobile and sedentary aspects (Richards 1990). The proportion of bones from wild species in the Neolithic levels at Cherhill, Wiltshire was higher than expected, and though Grigson (1983) suggests some may be residual from the Mesolithic occupation on the site, there is no clear evidence for this. The earliest Neolithic sites in Surrey are small and situated on riversides, possibly representing a river based economy (Field and Cotton 1987).

Livestock might be included in a mobile life-style with little change (Donahue 1992). Ingold (1983) argues that although the life-styles may appear similar the unpredictability of hunting would encourage very different attitudes to the predictable, planned economy of pastoralists. However, if the Mesolithic population was familiar with planning the exploitation of predictable marine resources, especially salmon runs, the change in attitude and outlook may have been small. It seems probable that there was a variety of economic types in the early Neolithic. Some groups might have depend largely on wild resources, others on livestock or led a more settled life were cereals were more important. The apparent differences in the relationship between early Neolithic settlement distribution and soil types in the neighbouring counties of Leicestershire (Clay 1989) and Northamptonshire (Martin and Hall 1980) may provide some support for this. All these groups might use diagnostically Neolithic artefacts if the artefacts were related to the social rather than economic sphere.

Several authors have argued for a mobile early Neolithic population. The lack of evidence for settlements associated with monuments in the lower Welland valley, has led French (1990) to suggest a mobile population, using several ecological zones within a small geographical area. In the Peak District the scarcity of early Neolithic material compared to the quantity of late Mesolithic and late Neolithic flint scatters may suggest small, widely scattered early Neolithic communities (Hart 1986). Ford (1987b) suggests an ephemeral early Neolithic in southern England, with most sites small and short lived, and follows Case (1986) in interpreting enclosures as foci for a dispersed, fairly mobile population. Reed (1974) suggests a more long term pattern of mobility in the early Neolithic by assuming long barrows of the same length were built by the same group. By joining the

nearest barrows of the same length he suggests migration patterns for these groups. However, it is often difficult to identify the actual length of eroded barrows, and it would seem reasonable to consider alternative explanations for variation in barrow length before taking this hypothesis too seriously. If the early Neolithic population was mobile it is likely that groups were restricted to fairly small areas. Barrows may indicate claims to territories. The Sweet Track, Somerset Levels, suggests long term occupation of the area, and considerable knowledge of local problems and solutions. It is a large undertaking suggesting organisation, not only to construct the tracks, but to provide enough coppiced timber (Coles 1978).

The major differences between the cultures would appear to be monumental or have possible importance as social symbols. The change from microliths to leaf-shaped arrowheads all over Britain would seem to be significant. Microlithic armatures seem to be a response to the risks associated with encounter hunting (Myres 1987, Edmonds 1987); they must have been efficient and reliable, and the assumption, made by Whittle (1977), that leaf-shaped arrowheads were naturally superior seems to have little basis. It seems more probable that the leaf-shaped arrowhead was designed for a different purpose to the microlithic one. Leaf-shaped arrowheads have been interpreted as objects of war and display (Pitts and Jacobi 1979, Edmonds and Thomas 1987, Kinnes 1988). They would be effective as lethal weapons, and there is evidence that they were used as such, but they are also beautifully made, and more visible than tiny microliths. In third millennium burials, where arrowheads can be associated with a single individual, this person is usually male, suggesting they were part of male kit, not status symbols, but important in the general image of maleness (Edmonds and Thomas 1987). Polished axes, though probably important agricultural tools, also seem to have had another, probably symbolic function (Edmonds 1987). They were widely exchanged and in some areas there is much less evidence of their use in practical tasks than might be expected (Gardiner 1990). The relationship of pecked axes found in Welsh Mesolithic contexts (David 1985) to Neolithic polished axes is unknown, but worthy of speculation.

Pottery is usually assumed to be utilitarian, but Malmer (1984) points out that wood or skins would probably be more efficient and pleasant for cooking in and drinking from; pottery possibly having a predominantly ritual function. The association of pottery with early burial deposits may suggest that its original function was symbolic, domestic use being a later development (Kinnes 1988, Herne 1988). Malmer's pile dwelling site of Alvastra, brings to mind the island site of Loch Olabhat, North Uist (Armit 1986-1990). The Loch Olabhat is built on a possibly artificial island in a lake so shallow that the situation gives little defensive advantage. It also possessed an impressive stone entrance

way, timber palisade, and large quantities of mainly decorated pottery. The general scarcity of pottery in Scotland, especially decorated wares of this high quality could suggest that both the site and the pottery did not have a purely domestic function. The number of querns from later layers of this site may also be important considering the rarity of querns in Britain, especially Scotland (Field *et al* 1964, Kinnes 1988).

Burial monuments and causewayed camps clearly had some non-domestic function, and even agriculture, the adoption of which does not seem to have been a response to a resource crisis, may have been more closely related to social and ritual needs than to economic ones. Kan (1986) has argued the importance of the role of mortuary ritual in maintaining social coherence among the Tlingit of north-west North America, and mortuary and other rituals seem to have played a part in establishing a new social order in early Neolithic Britain. It seems possible that the two cultures in Great Britain were actually quite similar, except for the very characteristics that define the change being investigated. The use of pottery and leaf-shaped arrowheads, the construction of monuments and the adoption of agriculture can be accounted for by social, rather than economic change, one that may initially have been merely a slightly different expression of existing ideas and beliefs.

Whittle (1977) argues that the speed with which the Neolithic seems to have spread across Britain precludes acculturation, but this speed has yet to be demonstrated. Even if the first appearance of recognisably Neolithic artefacts can be taken to represent the spread of Neolithic ideas and material culture across Britain similar radiocarbon dates for this event cannot prove that it occurred at the same time every where. A single average date covers a range of about 400 years³⁰. Two identical dates on different sites at opposite ends of the country could represent events falling at any time within that 400 year span; one site could be from early in that range and one from late. Social and economic change occurring over possibly fifteen generations can hardly be described as sudden. We cannot yet determine whether the change was rapid or not, though an increased number of reliable dates would improve the situation.

While an active role for the native population of Britain seems to fit the evidence of the early Neolithic quite well, there is no supporting evidence for the late Mesolithic to explain the desire for Neolithic culture. Most acculturation models rely on the

30. As most dates were measured some years ago they have an error of about ± 100 i.e. ± 200 at two standard deviations giving a full date range of 400 years. More recent dates are more precise, though only sites with a number of dates on relevant features could be compared with any reliability and at present these are rare.

development of some degree of social complexity in the native population, but the poverty of the late Mesolithic evidence from Britain can provide little support that this occurred. The chance of finding such evidence has been reduced by the necessary concentration of much research on upland areas where sites are better preserved. As most are temporary task sites upland sites are less likely to preserve indications of social complexity. Even so some of these sites are larger than others, and have been suggested as meeting places of several groups (Spratt 1982). While many early Mesolithic sites have a balanced mixture of artefact types, late Mesolithic ones seem to be more varied, some being balanced but some having predominantly scrapers or microliths (Myers 1987). This may indicate an increase in logistic strategies, with distinct base camps and task sites. Logistic strategies may not always be easily identified, as task sites have a low archaeological visibility, and the loss of coastal base camps in England and Wales could be high.

Cemeteries have been important in indicating a level of social complexity in the southern Scandinavian Mesolithic, but there is only one known from Britain (Neeley and Clark 1990). This is Aveline's Hole, Burrington Combe on the north side of the Mendips, which was used as a cemetery in the 7th millennium bc, and up to 50 individuals have been found. The area seems unlikely to have supported a sedentary settlement, but may have been a permanent funerary site for mobile groups (Jacobi 1987). The absence of burials later in the Mesolithic does not necessarily indicate a simple, egalitarian society, as exposure or sea burials may be as indicative of social stratification as inhumations, but will not survive in the archaeological record.

With no known late Mesolithic burials in Britain it is clearly not possible to determine whether or not there was any continuity in burial traditions across the Transition. Flat graves, generally, though not exclusively, containing single burials were used in southern Scandinavia (Larsson 1990, Petersen 1987), and flat graves do occur in the British Neolithic (Ashbee 1982). Perhaps exposure was a significant burial tradition in the British Mesolithic, and this practice is seen in bodies from Neolithic tombs. Human bones found in the Oronsay middens are predominantly hand and foot bones. These appear to have been deposited haphazardly (Meiklejohn and Denston 1987), and may represent complex excarnation and selective deposition of bones in the Mesolithic (Pollard 1990).

Social complexity has been associated with an increase in territoriality, a decrease in territory size, and associated reduction in mobility. There have been attempts to study territories in the archaeological record, but they are rarely very convincing. Jacobi (1979) identified 5 technological groups based on microlith types, which had marked

geographical patterning. He interpreted these as representing social groupings. The similarity of some of these groups to geographical groupings of Neolithic artefacts, especially in the south-west (Mercer 1986 p40, Darvill 1987), has encouraged the consideration of these as social territories. However, Jacobi (1987) has reassessed his own approach, and doubts that social territories can be so easily recognised. It cannot be assumed that the differences in microlith type are stylistic differences related to social groupings. In particular the group Jacobi (1979) identified on the Pennines and in Cleveland might be explained by the functional demands of upland hunting sites, rather than by style. Arguing for an increase in territorial behaviour, or increase in population from this data is very difficult.

Increased territoriality may be related to increased sedentism, and sedentism is often associated with other aspects of social complexity. *"To date there is no British evidence for 'sedentary hunters'. This does not mean, however that such did not exist"* (Jacobi 1987 p165). There is no reason why sedentism should not have developed along the coast, especially estuarine areas, where resources are rich and diverse (Jacobi 1978, 1987). Salmon in particular could have provided an abundant, predictable food source. In such locations residential mobility may have been limited, even if actual permanent settlements did not develop (Bonsall 1980).

The most probable example of Mesolithic semi-sedentism in the British Isles is from the circular huts at Mount Sandel, Ireland, and this is early Mesolithic. The huts were fairly substantial, though the group using them must have been small as only one hut was erected at a time. The existence of specific activity areas suggests long term occupation, and there are possible storage pits. There was a large proportion of microliths, but wear analysis on these suggested they were used for many functions, not just as projectile points. There were few scrapers, but many blades had hide polish. It therefore appeared that there were a greater variety of activities than would be expected on a simple hunting site. Seasonal indicators suggest occupied for at least 3 seasons of the year, but cannot prove continual occupation (Woodman 1985). Nethermills with pits, possibly for storage, and quantities of finds, including a large number of scrapers, might be another candidate for semi-sedentary occupation (Kenworthy 1981). The Mesolithic site at Windmill Farm, Cornwall is argued to be a long term home base, from the high proportion of scrapers to microliths. Though hearths or middens were located the excavator suggests associated structures lay outside the excavated area (G Smith 1984).

Though most early Neolithic structures are a little larger and rectangular in plan, they are not greatly different to these more substantial Mesolithic structures (Ashbee

1982). Shallow hollows associated with early Neolithic occupation debris, e.g. at Dragonby, Lincolnshire (May 1976), and on various sites in Sussex (Drewett 1978), are particularly similar to many Mesolithic occupation sites. It is possible that substantial structures were a fairly late development generally associated with stable agriculture (Kinnes 1988).

Where the coasts have been preserved there is evidence that coastal sites seem to have been of considerable importance in the Mesolithic, especially in areas with productive estuaries. It is no coincidence that most examples of these sites come from Scotland and the North of England, where coastal submergence has been less, or isostatic rebound has been significant. Elsewhere in Britain many coastal sites must have been lost, and the available resources might suggest that these could have been fairly large and long term (Jacobi 1980). In Cornwall where there has been relatively little loss of the coastline, the vast majority of sites are located close to the coast. In Sussex Mesolithic sites are twice as dense along coast with high cliffs than low-lying coasts, possibly because sites in the latter area have been covered by alluvium (Palmer 1977).

The Williamson's Moss site has the remains of ^{several} ~~a~~ substantial timber platforms which appears to date to the same period as vegetational change in the area (Bonsall *et al* 1986), possibly indicating long term investment in a locality. The shell middens of Oronsay, Inner Hebrides, represent considerable exploitation of marine resources, but permanent occupation of the island cannot be demonstrated (Mellars 1987). Seasonal information from fish otoliths from the Oronsay middens indicate that the middens were used for a short period seasonally, but each midden was used at a different time of year (Mellars 1979). Between them the middens cover most of the year, but it is not known if they are all contemporary, though the dates suggest they are broadly synchronous (Switsur and Mellars 1987). Structures within the middens are slight, possibly for drying and preparing the fish, rather than occupation (Mellars 1979). Research has been restricted to the middens, until Mithen's recent work (1989) on the adjoining island of Colonsay, and semi-permanent settlements away from the middens would not have been identified.

Storage is an important pre-requisite for both an active exchange system and agriculture, yet evidence is again scarce from the British Mesolithic. Pits at Mount Sandel (Woodman 1978), and Nethermills (Kenworthy 1981) may have been for storage, but they could equally have been used for tanning, or any of a large range of functions. The lack of archaeological evidence for storage does not imply that it did not occur. Indians on the North West coast of North America stored food in boxes and hanging from house roofs (Deith 1985), though this requires more substantial structures than those usually found in Britain of a Mesolithic date.

In common with most of Mesolithic Europe there is no evidence of progression towards food production. Fire management of the natural environment was a commonly used by various purely hunter-gatherer groups (Lewis 1982), and cannot be taken to imply incipient domestication. There was no specialisation in a single species, instead an increasingly broad spectrum economy developed, which would probably have remained stable without external influence (Rozoy 1989).

The Mesolithic population, especially in some parts of Britain has been disregarded as being so small, as to have had no influence on supposed incomers (Childe 1934 p18-19). Atkinson (1962) mentions an estimate of "*no more than 125 persons*" in Mesolithic Scotland. Piggott (1953) uses analogy with the Caribou Eskimo to estimate the Mesolithic population of England and Wales at 7000, but this group would seem to live in a rather different environment and practised a different economy to that of Mesolithic Britain. Temperate hunter-gatherers in more similar environments e.g. the Ainu of Hokkaido Island, Japan, suggest population densities of up to 0.2 persons per km² (Gendel 1984). Late Mesolithic occupation is so widespread in Sussex, Hampshire and Dorset that, despite the long period represented, and other problems of estimating population, it seems unlikely that the population density was negligible. The rise in sea level and the increased productivity of the coast may have increased population density locally. The loss of sites around much of the coast of Britain due to further sea transgressions might have denied us knowledge of larger, more permanent settlements in the late Mesolithic. Gardiner (1984) considers it impossible for Neolithic groups to avoid impinging on existing territories, but there is no evidence in the archaeology of contact or conflict between the two groups. The suggestion by Pitts and Jacobi (1979) that there may have been "*no substantial human presence*" in southern Britain "*at the time of the earliest colonisations from the Continent*" (p170) seems hard to justify when the area had been occupied for so long. The lack of apparent cultural overlap would seem to support the acculturation model if local groups were rapidly converted to agriculturalists. Any conflict in the early stages of this process might be expected to involve social competition rather than violence, if the major reason of adopting Neolithic culture was for use in exchange and social relations. Even groups retaining a largely traditional society and economy may have been forced to use polished stone axes or pottery as a medium for exchange, and if their sites were excavated they would be classed as Neolithic on the strength of these artefacts.

While exchange across Britain in the Neolithic is clearly demonstrated by polished stone axes and some pottery types found considerable distances from their sources, evidence for Mesolithic exchange networks is scarcer. Small groups cannot survive in isolation, marriage networks and some degree of exchange being necessary to

their survival (Bender 1978); these characteristics must have existed in Mesolithic Britain. There is evidence that during the late Mesolithic the exchange networks in Britain did not include Continental groups. There is a fairly clear divergence of technology after the Channel was submerged, and no evidence for cultural links throughout the late Mesolithic (Jacobi 1976). The land bridge between Britain and the Continent was breached by 6400 bc, leaving a strait 15-20 miles wide. Though this strait was well within the capabilities of Mesolithic seamen to cross the development of broad blades trimmed into trapezoids, which spread 1000 miles north-south over mainland Europe in the sixth millennium, never reached Britain. No latest Mesolithic or pressure flaked points reached Britain despite their presence in the Low Countries, and presumably the barrier was social rather than physical (Jacobi 1976). Jacobi also points to the lack of bone and antler working to demonstrate the isolation of the British late Mesolithic, but bone working clearly continued in Scotland (Switsur and Mellars 1987, Bonsall and Smith 1989), and may have done so in the south. It is difficult to date isolated finds without using radiocarbon dating. Bonsall and Smith (1989) have done this for a number of antler mattocks, one of which from southern England dated to the fourth millennium, but could have been early Neolithic rather than late Mesolithic.

There is some evidence for trade in raw materials in southern England, particularly Portland chert, which moved around the country during both the Mesolithic and Neolithic. The following table gives some examples from Mesolithic sites ranging from as early as 7000 bc:-

<u>Material</u>	<u>Origin</u>	<u>Found at</u>
Portland chert	Portland, Dorset	Fresham Great Pond, West Surrey Oakhanger, Hampshire Broomhill, Hampshire Windmill Hill, Wiltshire Isle of Wight Gwithian, Cornwall
Slate	Cornwall	Wawcott, Oxfordshire North Devon Broomhill, Hampshire Hammerpot, Sussex
Sandstone	Kent or Sussex	Oakhanger, Hampshire
Brown flint	Yorkshire	Tweed valley
Black chert	Shaftesbury, Dorset	Wawcott
		(Care 1979, Case 1986, Froom 1964, Jacobi 1981, Mulholland 1970, Roberts 1987

Pebbles of Portland chert may have been transported by long shore drift, though slate is too soft to withstand transport by the sea, and its presence presumably implies exchange. However, even though the chert may be transported along the coast naturally pieces appearing in the west Weald must have been carried inland by people (Jacobi 1981). There are other outcrops of Portland chert in addition to that on Portland Bill e.g. in the Vale of Pewsey, so not all Portland chert need to have come from Portland itself (Pitts 1983). The quantity of Portland chert decreases with distance, pieces being found up to 240km from the main source, suggesting it was transported by hand to hand exchange (Care 1979). The use of Portland chert may indicate specialised exploitation in both the Mesolithic and Neolithic (Care 1982), though it was probably more hospitable than Care implies, and occupation there may have been part of the normal seasonal round, which would include raw material acquisition for most groups (Palmer 1989).

The movement of flint inland from a coastal source, such as occurred with Beer flint in the south-west, might suggest the territory of a single hunter-gatherer group, rather than exchange between groups (Care 1982). Some of the examples given above may be accounted for by the source of the stone being within the annual territory of the group on whose site the material was found. Piggott (1970) even attributes pebbles from the south-

west on Surrey sites to seasonal wanderings of Mesolithic groups rather than to exchange. As variation in artefact forms cannot be securely related to group identity, it is probably impossible to determine whether exchange or considerable population mobility is represented.

The exchange of Portland chert seems to continue into the Neolithic, apparently along the same network that distributed axes and pottery from the south-west, with causewayed enclosures seeming to play a role in the exchange (Care 1979). Pieces from New Feygate, Sussex, and Ash, Kent suggest the easterly trade of this chert in the Neolithic (Jacobi 1981). Field walking in the Exe valley produced four pieces of Portland chert, they were not diagnostic, but the author feels they are probably Neolithic (Silvester et al 1987). Portland chert arrowheads reached the south-west in the Neolithic (Care 1982). In Scotland there is a similar continuity in the exchange of certain raw materials. Rhum blood stone was used and exported from ca.8500 BP into the early Bronze Age. Arran Pitchstone was used over similar period, but moved over longer distances, as far as north-east Scotland, over 300km from its source, though there are only a very small number of pieces on the most distant sites (Wickham-Jones 1986).

A small proportion of microliths from Monk Moors, and larger proportion from St. Bees Head, Cumbria, are made of volcanic tuff, similar to that from which the group VI axes are made. But there is no evidence that this came from inland sources rather than from the coast as pebbles (Bonsall 1980). Tuff is also found in lithic scatters near Shap, Cumbria, where it could have been picked up locally, though some of the material represents Neolithic reworking of polished axes fragments (Cherry 1989). Rock of groups VIII and XXI were used for microliths on Anglesey, and it is possible that Mesolithic groups had a working knowledge of rock types later used for Neolithic axe production (Annable 1987).

Quarrying, knowledge of the best flint seams, and mass production of flint axes may have preceded the Neolithic flint mines. Late Mesolithic flint extraction in southern England appears to have involved digging to reach the best flint in gravels, if the "pit dwellings" at Farnham, Surrey are interpreted as quarries (Care 1979). At Farnham there is a series of shallow depressions in the gravel which contain worked flint. The presence of hearths in some of these lead the excavators to interpret them as pit dwellings (Clark and Rankine 1939). Care (1979) also suggests deep pipes, near Fort Wallington, Hampshire, previously interpreted as solution hollows may have been used to extract flint. The late Mesolithic site at Broomhill, Hampshire, also seems to be associated with large scale production of tranchet axes (Care 1979). However, Kinnes (1988) disregards Mesolithic

scoops and hollows as precursors of flint mining, as he considers them merely "*a natural extension of surface collection*" (1988 p4). However, in the Neolithic flint mining preceded the exploitation of surface clay-with-flint deposits; late Neolithic axes were made from surface not mined flint (Gardiner 1990). This is the reverse of what would be expected of an immigrant population with little knowledge of the area. Clay-with-flints are easily recognised, but mined flint may be in deep seams, rarely appearing on the surface. It would seem that considerable local knowledge would be necessary to locate these deposits (Gardiner 1990).

While in many areas, while there is a change in preferred sources between early and late Mesolithic, there is no similar change at the Mesolithic/Neolithic transition. In Yorkshire Wold flint was predominantly used in the early Mesolithic whereas drift flint from the coast was more common in the late Mesolithic and Neolithic (Keighley 1981). Field walking in the Exe valley revealed nodular flint which must have come from chalk (Silvester *et al* 1987). There was a lower proportion of primary flakes of this material than of the local chert, suggesting that the flint was imported. The chert cores found were generally longer, and where they had multiple platforms these were located so as to maximise the length of the flakes produced. The authors therefore suggest that the chert was used mainly in the Mesolithic and the flint in the Neolithic, though the problems of dating lithic scatters make this interpretation seem a little simplistic. In one particular concentration with several late Mesolithic-type microliths, the use of flint was higher than in other scatters containing mainly early Mesolithic microliths. This would suggest a change in raw material type occurring during the Mesolithic. This site is rather confused with many periods overlain so identification of period is problematic, however other sites in east Devon have evidence suggesting the change to flint occurred in the late Mesolithic. The general scarcity of late Mesolithic material in the area may suggest the focus of occupation moved to Dartmoor and North Devon in the late Mesolithic (Silvester *et al* 1987). In the limestone uplands of Cumbria the change from local chert to flint occurred in the late Neolithic, both late Mesolithic and early Neolithic artefacts being made predominantly from chert (Cherry 1989).

Evidence for continuity does, therefore, exist in Britain. It would appear that however agriculture, and other aspects of Neolithic culture, were introduced to Britain the change was perhaps not as extreme as sometimes portrayed. The data suggests both change and continuity, but at present reveals little about the process or timing of the introduction of agriculture. The first appearance of Neolithic-type artefacts and monuments is easier to date, but these represent the end of the process, and not how it occurred or which human groups were actively involved.

CHAPTER 8: CONCLUSIONS AND THE NEED FOR FUTURE RESEARCH

It seems extremely difficult to list what actually constitutes evidence for the earliest agriculture in Britain. There are numerous dates for the first recognisably Neolithic assemblages, which are associated with a variety of evidence for fairly intensive farming, but it seems unlikely that any preceding phase could be identified without a large programme designed to search for it. Certainly the radiocarbon dates reveal a gap in our knowledge which covers most of the fourth millennium bc. Assuming the Mesolithic population of Britain did not die out in this millennium, which there would seem to be no reason to assume, it suggests that there is a class of sites that have not been recognised and dated. Whether these sites were made by mobile or sedentary hunter-gatherers, pioneering colonist farmers or natives experimenting with cereal cultivation or in fact whether they were or were not related to agricultural practices, seems beyond the ability of the present data base to provide an answer. The dates from Ballynagilly and the possible early cereal-type pollen grains provide a tantalising suggestion of early farming in Britain, but the lack of evidence for Continental contacts before the full neolithic makes the sudden appearance and rapid spread of agriculture seem likely. Comparisons with southern Scandinavia suggest the possibility of complex hunter-gatherer groups actively adopting the trappings of a Neolithic way of life, but evidence for this complexity in Britain is presently lacking. The spread of Neolithic culture purely by population movement and expansion seems difficult to argue, but the effect of small scale migrations cannot be studied until more work has been done on both sides of the Channel identifying relationships in material culture and considering what these represent. It would seem necessary for this research to involve the excavation of submerged sites, to assess whether their economy and artefacts are the same as inland sites, and which may show evidence of early contact.

Southern Scandinavia might be taken as a model and as a starting point for new research might be to investigate whether the differences between the Transition there and in Britain are real or the result of poor data. A priority in the search might be the location of substantial late Mesolithic settlements, more supportive of the idea of complex societies than the huts presently recorded. Work on artefacts and economy might add to the already considerable suggestions of continuity between the two periods. Deliberate searches of southern English bogs might reveal more evidence for early cereal pollen, and a thorough dating programme of late Mesolithic and early Neolithic sites is desperately needed. The shell middens in Denmark have been preserved through isostatic uplift (Gebauer and Price 1990, Price and Gebauer 1992, Larsson 1985), and it might be worthwhile concentrating on areas of Britain with raised beaches, instead of assuming regions closest to the Continent

will provide the earliest information. There has ~~not~~ been less loss of coast in the West Country, particularly Cornwall, because of its hard bed rocks and because it does not suffer from down-warping like the east of England (Morrison 1980). Coastal sites are therefore preserved there, but the raised beaches of Scotland would seem to have particular potential. Neolithic ideas and technology were clearly present in the Dee valley at the same time as they appeared in Wiltshire and Sussex. There is also no reason to assume the Scottish Neolithic was in any way provincial or derived (Kinnes 1985). Shell middens along the Forth Estuary and the west coast have provided late dates for Mesolithic activity and evidence for continuity of resource exploitation. One of the greatest problems of studying the British late Mesolithic is the scarcity of organic material for radiocarbon dating, and to provide economic evidence, yet the shell middens provide an alkaline environment in which organics, particularly bone can be preserved. Occasional ovicaprid bones have been recovered from some of these middens³¹, and an initial project might involve dating these. These middens have disadvantages, their structure is loose and the stratigraphy is often uncertain, they also appear to be task sites for the exploitation of specific resources, reducing the possibility that evidence of social complexity might be discovered with-in them. However, the recovery of dates, preferably from bone artefacts, from these middens would contribute considerably to the understanding of the chronology of the Transition. An early date on one of the ovicaprid bones could date the introduction of livestock to the area without the having to rely on the poor stratigraphy of the middens.

Excavation of flint scatters, close to the middens or at suitable inland locations, might reveal associated base camps. It seems unlikely that sites transitional between typical Mesolithic and Neolithic cultures will be found in the more marginal environments of upland. Coastal, especially estuarine locations seem most likely to have supported groups similar to those who occupied southern Scandinavia (Gebauer and Price 1990, Price and Gebauer 1992, Larsson 1985). There is no guarantee that such searches will reveal a new aspect to the British late Mesolithic, but the attempt would at least allow better judgement of the proposed models.

31. 2 ovicaprid bones from MacArthur Cave and 6 from Druimvargie, Oban (Finlay 1982), and several from Ulva, Mull (Bonsall *et al* 1992). The latter are associated with the upper, possibly early Neolithic layers of the midden, but the former are associated only with Obanian material, though mixing of layers may have occurred.

8.1 Final conclusion

The conclusion of this thesis must be that there is a great deal to be done before the beginnings of agriculture in Great Britain can be properly addressed. A greater awareness of what the evidence really means needs to be injected into the discussion. Radiocarbon dating and palynology can provide important data, but this data has limitations, which must be acknowledged if useful questions are to be asked of the data, instead using it incorrectly to bolster a favoured theory. The spatial distribution of sites would appear to be highly problematic, and it is hard to determine just what questions can be justifiably asked of this data. The Dee valley study demonstrated both that existing patterns can be changed very easily, and that there may be hope of gleaning some genuine information with the application of sufficient research. It is clear that generalisations about distribution patterns can be misleading, and the biases must be carefully considered in all cases.

The need for the archaeological community in general to come to terms with the true nature of radiocarbon dates cannot be over stressed. Only then will dates be taken in a sensible way and interpreted with some degree of reality. Radiocarbon dating may be absolute, but it is not exact, and it is unlikely that it ever will be. A brief comment on the inaccuracies of radiocarbon at the start of an article is inadequate if the article proceeds to ignore the full implications of these inaccuracies.

Models based on anthropological and other evidence are numerous, most probable explanations for the origin of agriculture and its adoption beyond centres of origin must have been discussed in the literature at some time, but they are of little use if they cannot be related to specific cases. I would suggest that, although it is weighted slightly towards the acculturation model, the evidence from Britain is inadequate to determine how or even when the transition to agriculture occurred. Though this study has achieved little of a positive nature, it has formed a useful catalogue of the inherent errors in archaeological methods, and serves to support Binford's obvious, but easily ignored statement that the archaeological record *"is very much part of our contemporary world and the observations we make about it are in the here and now"* (Binford 1988 p19). The archaeological record is the final product of a vast number of taphonomic processes, and our contemporary hypotheses can only be tested against this contemporary record. Despite having suffered from naive concepts of fossil societies, untouched by history, anthropology is now also well aware of the contemporary nature of its evidence, making it no more of a direct window into the Past than the archaeological record.

As this thesis has dealt with the nature of archaeological data in relation to a particular problem it may be appropriate to make a final comment on the nature of archaeology itself. Leach (1977 p166-7) has considered the study of the past. Even in recent history it is impossible to know more than "*a tiny, insignificant fraction of that vast mountain of circumstance*" that constituted the past (Leach 1977 p166-7). Further back in time the quantity and quality of evidence decreases, the cultures become increasingly remote to our own, and that fraction of possible knowledge is reduced. "*It follows that the past with which history deals is not the past of real time; rather it is a past encapsulated in the minds of men of the present*" (Leach 1977 p166-7). Can we really know how the Transition occurred in Britain, or any-where else, or do we merely consider ways we would have liked this major event to have occurred; determined pioneers, maritime adventurers, charismatic leaders, skilful traders, or even environmental determinism? Without a critical approach to the evidence and a genuine attempt to test theories, these are little more than stories. But however rigorous the analysis of the data we have no hope of recognising the truth, particularly in this field where the outlook of these ancient societies would seem to be so important. Personally I find that many of the social models for the Transition make sense to me at an instinctive level. This should, perhaps, be taken as a warning, as it seems unlikely that I could have an instinctive understanding of the temporarily and culturally distant period I have been discussing. Many of these social hypotheses are remarkably appropriate to the contemporary situation, with our concerns about appropriation of material wealth and power, and the awareness and fear of the social control "big men" or big companies have through control of the economy. If it is imagined that a complete archaeological record could be discovered, would we be capable of breaking free of our cultural and temporal perceptions to interpret it correctly?

If we can never discover the truth what do we gain from conducting archaeological research? Hodder (1990) is worth quoting at length: "*We can only think through experience. In my view the importance of archaeology in the modern world is that it provides another experience - the experience of the past- through which one can objectify and think our present thoughts. We can only change the [intellectual and social] structures that bind us once they have been thought. The artefacts from the past, excavated in material contexts and ordered partly by material constraints, provide a wealth of experience through which the present can be thought about and thus changed. This is the ultimate reason that I delve....into the complex and detailed information for the European Neolithic*" (p19). If we succeed in learning about the Present through archaeology, our failure to find the truth about the Past may be of little significance. As coda to my work I would like to

list briefly some aspects of what I see as the real value of studying the beginnings of agriculture, with some specific references to my own research. Obviously these are personal views, and open to question as to their value, but I would include the practice of reasoned debate as one of the values of archaeology in general.

The study of the beginnings of agriculture promotes consideration of the following subjects, which are relevant to our present world and experience:-

A greater understanding about the cultural complexity of cultures previously considered to be inferior and simple. The discussion of these groups in our own country brings them closer to us, as our geographical if not actual genetic ancestors, than perhaps anthropological reports of modern groups can do.

Agriculture is the basis of our society, consideration of groups living effectively without it, and possibly choosing not to adopt it, may put our opinions of it in a better perspective. If we can see that agriculture is not naturally and inevitably superior it may possibly alter the way we perceive groups with other economies and ideals.

Agriculture has proved, at least in the evolutionary short term, to be a great evolutionary advantage to the human race, allowing its unrivalled expansion, but consideration of the beginnings of this process act as a reminder that this was not a deliberate, planned process, and human social evolution, like physical evolution, is blind and undirectional.

Hopefully this thesis has demonstrated the value of questioning the evidence, of any sort; the value of discovering what the "experts" mean when they make a statement, and in what way their data can be applied, instead of placing words in their mouths through misinterpretation, or considering their opinions as above question.

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